

SYSTEMS TECHNOLOGY, INC.

2672 BAYSHORE FRONTAGE ROAD • MOUNTAIN VIEW, CALIFORNIA 94043 • PHONE [415] 961-4674

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SEVERAL AIRCRAFT TO ATMOSPHERIC TURBULENCE  
AND DISCRETE WIND SHEARS Final Report  
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COMPUTED RESPONSES OF SEVERAL AIRCRAFT  
TO ATMOSPHERIC TURBULENCE AND DISCRETE WIND SHEARS

Wayne F. Jewell  
Robert L. Stapleford  
Robert K. Heffley

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Ames Research Center  
Moffett Field, CA 94035

## FOREWORD

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## ABSTRACT

The computed RMS and peak responses due to atmospheric turbulence and discrete wind shears, respectively, are presented for several aircraft in different flight conditions. The responses are presented with and without the effects of a typical second order washout filter. A complete set of dimensional stability derivatives for each aircraft/flight condition combination evaluated is also presented.

# TABLE OF CONTENTS

SECTION		PAGE
I	INTRODUCTION . . . . .	1
II	MODEL DEFINITION . . . . .	3
	A. Uncoupled Aircraft Equations of Motion . . . . .	3
	B. Kinematic Equations . . . . .	3
	C. Atmospheric Turbulence . . . . .	3
	D. Wind Shear . . . . .	10
	E. Washout Logic . . . . .	12
	F. Pilot Model . . . . .	13
III	DESCRIPTIONS OF AIRCRAFT AND FLIGHT CONDITIONS . . . . .	14
	A. General Descriptions of Aircraft . . . . .	14
	B. General Descriptions of Flight Conditions . . . . .	17
	C. Numerical Descriptions of Flight Conditions . . . . .	25
IV	RESULTS . . . . .	47
	REFERENCES . . . . .	68

# LIST OF TABLES

	PAGE
II-1    Uncoupled Aircraft Equations of Motion . . . . .	4
II-2    Required Kinematic Equations . . . . .	5
II-3    Equations for the Linear and Angular Components of Atmospheric Turbulence . . . . .	7
III-1   Flight Condition Descriptions . . . . .	18
III-2   Trim Conditions and Stability Derivatives, Longitudinal, U.S. Units . . . . .	26
III-3   Trim Conditions and Stability Derivatives, Lateral- Directional, U.S. Units . . . . .	31
III-4   Trim Conditions and Stability Derivatives, Longitudinal, S.I. Units . . . . .	36
III-5   Trim Conditions and Stability Derivatives, Lateral- Directional, S.I. Units . . . . .	41
IV-1    Longitudinal Results, U.S. Units . . . . .	48
IV-2    Lateral-Directional Results, U.S. Units . . . . .	53
IV-3    Longitudinal Results, S.I. Units . . . . .	58
IV-4    Lateral-Directional Results, S.I. Units . . . . .	63

## LIST OF FIGURES

	PAGE
II-1 Probability of Encountering Turbulence . . . . .	9
II-2 Turbulence Scale Factor Versus Probability of Exceedance for Constant Values of Altitude . . . . .	11

## LIST OF ABBREVIATIONS

c.g.	Center of gravity. Units are those associated with the the particular aircraft.
FRL	Fuselage reference line
RMS	Root mean square

# LIST OF SYMBOLS

$b$	Wing span or characteristic width
$g$	Acceleration of gravity
$h$	Perturbed altitude of the aircraft
$h_o$	Initial altitude of the aircraft with respect to sea level
$h_R$	Reference altitude used to calculate the gust scale lengths
$K_\theta$	Pilot model gain in pitch axis
$K_\phi$	Pilot model gain in roll axis
$L_u, L_v, L_w$	Scale lengths used in the atmospheric turbulence model
$l_x, l_z$	The x and z components of the pilot station with respect to the aircraft c.g.
$P$	Probability of exceedance
$P_1$	Probability of encountering turbulence
$p, q, r$	Components of the aircraft angular velocity with respect to an aircraft body-fixed axis system in the x, y, and z directions, respectively
$p_g, q_g, r_g$	Angular components of atmospheric turbulence with respect to an aircraft body-fixed axis system in the x, y, and z directions, respectively
$SF$	Scale factor used to compute RMS responses for values of P other than 0.01
$s$	Laplace operator
$T_E$	Pilot lag
$T_L$	Pilot lead
$U_o, W_o$	x and z components of the aircraft trim velocity with respect to the aircraft body axis system
$u, v, w$	Linear perturbation components of the aircraft velocity with respect to an aircraft body-fixed axis system in the x, y, and z directions, respectively



$\eta_1, \eta_2, \eta_3, \eta_4$	Uncorrelated white noise sources with unity power spectral density
$u_g, v_g, w_g$	Linear components of atmospheric turbulence with respect to an aircraft body-fixed axis system in the x, y, and z directions, respectively
$V_{hw}$	Discrete wind shear in either the x or y directions of the earth axis system
$V_{T_0}$	Magnitude of the trim aircraft velocity with respect to the air mass
$W$	Aircraft weight
$x, y$	Perturbed components of the aircraft position with respect to an earth-fixed axis system
$\alpha_0$	This parameter defines the axis system of the stability derivatives. $\alpha_0 = 0$ implies the stability derivatives are with respect to the conventional body-fixed stability axis system. $\alpha_0 = \alpha_t$ implies the stability derivatives are with respect to the FRL body-fixed axis system
$\alpha_t$	Trim angle of attack with respect to the FRL
$\beta$	Sideslip angle, $v/V_{T_0}$
$\beta_g$	$v_g/V_{T_0}$
$\gamma_0$	Initial flight path angle
$\delta_a$	Aileron or primary roll control
$\delta_e$	Elevator or primary pitch control
$\theta_0$	Initial pitch attitude of the aircraft
$\sigma_p$	RMS value of the p-component of atmospheric turbulence
$\sigma_u, \sigma_v, \sigma_w$	RMS values of the atmospheric turbulence in the x, y, and z directions with respect to aircraft axis system
$\phi, \theta, \psi$	Perturbation components of the aircraft Euler angles
$\sigma_R$	Mode of the Rayleigh density function for $\sigma_u$

## SUBSCRIPTS

p	At pilot station
wo	Washed out
g	Gust

## SECTION I

### INTRODUCTION

When using a motion simulator to conduct experiments involving piloted aircraft the researcher may ask the following questions: "How much motion is required to represent the piloted aircraft in a given flight condition?" and "Will these motions be within the capabilities of available simulators?" This report presents gust induced motion requirements of several aircraft in different flight conditions, and hence provides the researcher with a rough guide for answering the above questions. These motion requirements are based on computations of:

1. RMS response to atmospheric turbulence.
2. Peak response to a discrete wind shear.

The response calculations were done with and without the effects of a second order washout filter. A reasonable upper limit was used for the filter break frequency, and thus the results should be representative of the maximum effects of simulator motion logic.

It was desired that the results be indicative of responses when a pilot is flying the aircraft. However, because of the number of configurations, a complete multiloop pilot/vehicle analysis for each aircraft/flight condition combination was too costly. Thus a relatively simple pitch and roll attitude pilot model was designed for each aircraft/flight condition combination. The pilot models stabilize the phugoid and spiral modes (which would otherwise tend to dominate the response calculations), and thus perform one of the major functions of a real pilot.

Section II of this report contains descriptions of the mathematical models used to make the response calculations. These models include the

aircraft dynamics, atmospheric turbulence, wind shear, washout logic, and pilot model.

Section III contains descriptions of the aircraft and flight conditions evaluated. These include a complete set of stability derivatives for each aircraft/flight condition combination.

Section IV contains the tabulated results.

## SECTION II

### MODEL DEFINITION

#### A. UNCOUPLED AIRCRAFT EQUATIONS OF MOTION

The uncoupled, small perturbation equations of motion used here are given in Table II-1. These equations are written with respect to an aircraft body-fixed axis system. They include provisions for one longitudinal and one lateral-directional control ( $\delta_e$ ,  $\delta_a$ ), random gusts with respect to all axes ( $u_g$ ,  $w_g$ , etc.), and a discrete wind with respect to the horizon ( $V_{hw}$ ). A complete discussion of these equations and their stability and control derivatives can be found in Reference 1.

#### B. KINEMATIC EQUATIONS

Table II-2a relates the aircraft Euler angle rates to the aircraft body axis angular rates. Note that the Euler angles would also be the gimbal angles of an aircraft simulator if the motion were one-to-one and the gimbals were arranged in the sequence  $\Psi$ ,  $\Theta$ ,  $\Phi$  progressing from earth to body.

Table II-2b contains expressions for the accelerations of the pilot station with respect to an earth-fixed axis system. Accelerations, velocities, and displacements are expressed in an earth-fixed axis system and would correspond to the motion of a simulator if it were to follow the actual aircraft's motion one-to-one. (The vertical offset of the pilot station from the aircraft c.g. has been neglected in the expression for  $\ddot{x}_p$ .)

#### C. ATMOSPHERIC TURBULENCE

The aircraft RMS response to atmospheric turbulence with and without motion washout filters was computed for all aircraft states except the

TABLE II-1

## UNCOUPLED AIRCRAFT EQUATIONS OF MOTION

## A. LONGITUDINAL

$$\dot{u} = X_u (u - u_g) + X_w (w - w_g) + X_q (q - q_g) - W_o q - (g \cos \theta_o) \theta \\ + X_{\delta_e} \delta_e - (X_u \cos \theta_o + X_w \sin \theta_o) V_{hw} + (X_q \sin \theta_o / V_{T_o}) \dot{V}_{hw}$$

$$\dot{w} = Z_u (u - u_g) + Z_w (w - w_g) + Z_{\dot{w}} (\dot{w} - \dot{w}_g) + Z_q (q - q_g) + U_o q \\ - (g \sin \theta_o) \theta + Z_{\delta_e} \delta_e - (Z_u \cos \theta_o + Z_w \sin \theta_o) V_{hw} \\ + (Z_q \sin \theta_o / V_{T_o}) \dot{V}_{hw}$$

$$\dot{q} = M_u (u - u_g) + M_w (w - w_g) + M_{\dot{w}} (\dot{w} - \dot{w}_g) + M_q (q - q_g) + M_{\delta_e} \delta_e \\ - (M_u \cos \theta_o + M_w \sin \theta_o) V_{hw} + (M_q \sin \theta_o / V_{T_o}) \dot{V}_{hw}$$

## B. LATERAL-DIRECTIONAL

$$\dot{\beta} = Y_v (\beta - \beta_g) + \frac{Y_p}{V_{T_o}} (p - p_g) + \frac{Y_r}{V_{T_o}} (r - r_g) + \frac{W_o}{V_{T_o}} p - \frac{U_o}{V_{T_o}} r \\ + \frac{g \cos \theta_o}{V_{T_o}} \phi + Y_{\delta_a}^* \delta_a - \frac{Y_v}{V_{T_o}} V_{hw} - \frac{Y_r}{V_{T_o}^2} \dot{V}_{hw}$$

$$\dot{p} = L_{\beta}' (\beta - \beta_g) + L_p' (p - p_g) + L_r' r + L_{\delta_a}' \delta_a - \frac{L_{\beta}'}{V_{T_o}} V_{hw}$$

$$\dot{r} = N_{\beta}' (\beta - \beta_g) + N_p' (p - p_g) + N_r' (r - r_g) + N_{\delta_a}' \delta_a \\ - \frac{N_{\beta}'}{V_{T_o}} V_{hw} - \frac{N_r'}{V_{T_o}} \dot{V}_{hw}$$

TABLE II-2  
REQUIRED KINEMATIC EQUATIONS

A. EULER ANGLES

$$\dot{\phi} = p + (\tan \theta_0) r$$

$$\dot{\theta} = q$$

$$\dot{\psi} = (\sec \theta_0) r$$

B. LINEAR MOTIONS AT THE PILOT STATION

$$\ddot{x}_p = (\cos \theta_0) \dot{u} + (\sin \theta_0) \dot{w} + (W_0 \cos \theta_0 - U_0 \sin \theta_0) q$$

$$\ddot{y}_p = V_{T_0} \dot{\beta} - l_z \dot{p} + l_x \dot{r} - W_0 p + U_0 r$$

$$\ddot{h}_p = (\sin \theta_0) \dot{u} - (\cos \theta_0) \dot{w} + l_x \dot{q} + (W_0 \sin \theta_0 + U_0 \cos \theta_0) q$$

linear positions without washout filters ( $x_p, y_p, h_p$ ), which were excluded because their RMS responses are unbounded.

For the longitudinal cases this involved the evaluation of the aircraft response to random gusts parallel and perpendicular to the aircraft's FRL x-axis ( $u_g, w_g$ ). The effect of an axial variation in  $w_g$  ( $q_g$ ) was also included.

For the lateral-directional cases this involved the evaluation of the aircraft response to random gusts parallel to the aircraft's y-axis ( $v_g$ ) and to roll gusts\* ( $p_g$ ). The effect of an axial variation in  $v_g$  ( $r_g$ ) was also included.

For the lateral-directional case the RMS values of the states  $\dot{y}_p$  and  $\psi$  only include the effects of  $v_g$ . This is because their RMS responses to  $p_g$  are unbounded.

The subsections below contain a succinct description of the atmospheric turbulence model used and a description of a method for scaling the RMS response data contained herein to different values of probabilities of exceedance.

## 1. Model Definition

The atmospheric turbulence model specified in References 2 and 3 was used. For convenience the bare essentials of that model are reproduced below.

Equations for the linear ( $u_g, v_g, w_g$ ) and angular ( $p_g, q_g, r_g$ ) components of atmospheric turbulence with respect to the aircraft body axis are delineated in Table II-3. In these equations  $\eta_1, \eta_2, \eta_3$ , and  $\eta_4$  are uncorrelated white noise sources with unity power spectral density.  $\sigma_u, \sigma_p$ , and  $\sigma_w$  are the RMS levels of the  $u, v$  ( $\sigma_p = \sigma_v/V_{T0}$ ), and  $w$  components of the atmospheric turbulence, respectively. All are functions of the aircraft altitude ( $h_0$ ) and a specified probability of exceedance ( $P$ ). These functions are defined below.

The Rayleigh distribution function of Equation II-1 was used to calculate  $\sigma_u$ .

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\* Roll gusts result from a spanwise variation of the vertical gusts.



TABLE II-3

EQUATIONS FOR THE LINEAR AND ANGULAR COMPONENTS  
OF ATMOSPHERIC TURBULENCE

$$u_g = \sigma_u \sqrt{\frac{2V_{T_O}}{L_u}} \left[ \frac{1}{s + \frac{V_{T_O}}{L_u}} \right] \eta_1$$

$$w_g = \sigma_w \sqrt{\frac{3V_{T_O}}{L_w}} \frac{s + \frac{V_{T_O}}{\sqrt{3} L_w}}{\left(s + \frac{V_{T_O}}{L_w}\right)^2} \eta_2$$

$$\beta_g = \sigma_\beta \sqrt{\frac{3V_{T_O}}{L_v}} \frac{s + \frac{V_{T_O}}{\sqrt{3} L_v}}{\left(s + \frac{V_{T_O}}{L_v}\right)^2} \eta_3$$

$$p_g = \sigma_w \sqrt{\frac{0.8 \pi}{L_w V_{T_O}}} \left( \frac{\pi L_w}{4b} \right)^{1/6} \left[ \frac{\pi V_{T_O}/4b}{s + \pi V_{T_O}/4b} \right] \eta_4$$

$$q_g = \left[ \frac{-\pi/4b}{s + \pi V_{T_O}/4b} \right] \dot{w}_g$$

$$r_g = \left[ \frac{\pi V_{T_O}/3b}{s + \pi V_{T_O}/3b} \right] \dot{\beta}_g$$

$$P = P_1 \cdot \text{EXP} \left[ -\frac{1}{2} \left( \sigma_u / \sigma_R \right)^2 \right] \quad \text{II-1}$$

$$\sigma_R = 0.70 \text{ m/s (2.3 ft/s)}$$

The parameter  $P_1$  in Equation II-1 is the probability of encountering turbulence at an altitude  $h_o$ . It is plotted in Figure II-1 for altitudes up to 30,480 m (100,000 ft). The parameter  $P$  was set to 0.01 for all work contained in this report (i.e., a 1% probability of exceedance). The parameter  $\sigma_R$  is the mode of the Rayleigh density function for  $\sigma_u$  (note that  $\sigma_R^2$  is one half the expected value of  $\sigma_u^2$ ).

$\sigma_w$  and  $\sigma_v$  are functions of  $\sigma_u$  and the scale lengths ( $L_u$ ,  $L_v$ ,  $L_w$ ). The scale lengths are functions of altitude. Mathematical expressions for all these parameters are given in Equations II-2 through II-6.

$$\sigma_v = \sigma_u \quad \text{II-2}$$

$$\sigma_w = \sigma_u \sqrt{\frac{L_w}{L_u}} \quad \text{II-3}$$

$$L_u = \begin{cases} h_R & \text{for } h_o \geq h_R \\ \left( h_R^2 h_o \right)^{1/3} & \text{for } h_o \leq h_R \end{cases} \quad \text{II-4}$$

$$L_v = L_u \quad \text{II-5}$$

$$L_w = \begin{cases} h_R & \text{for } h_o \geq h_R \\ h_o & \text{for } h_o \leq h_R \end{cases} \quad \text{II-6}$$

$$h_R = 533 \text{ m (1750 ft)}$$

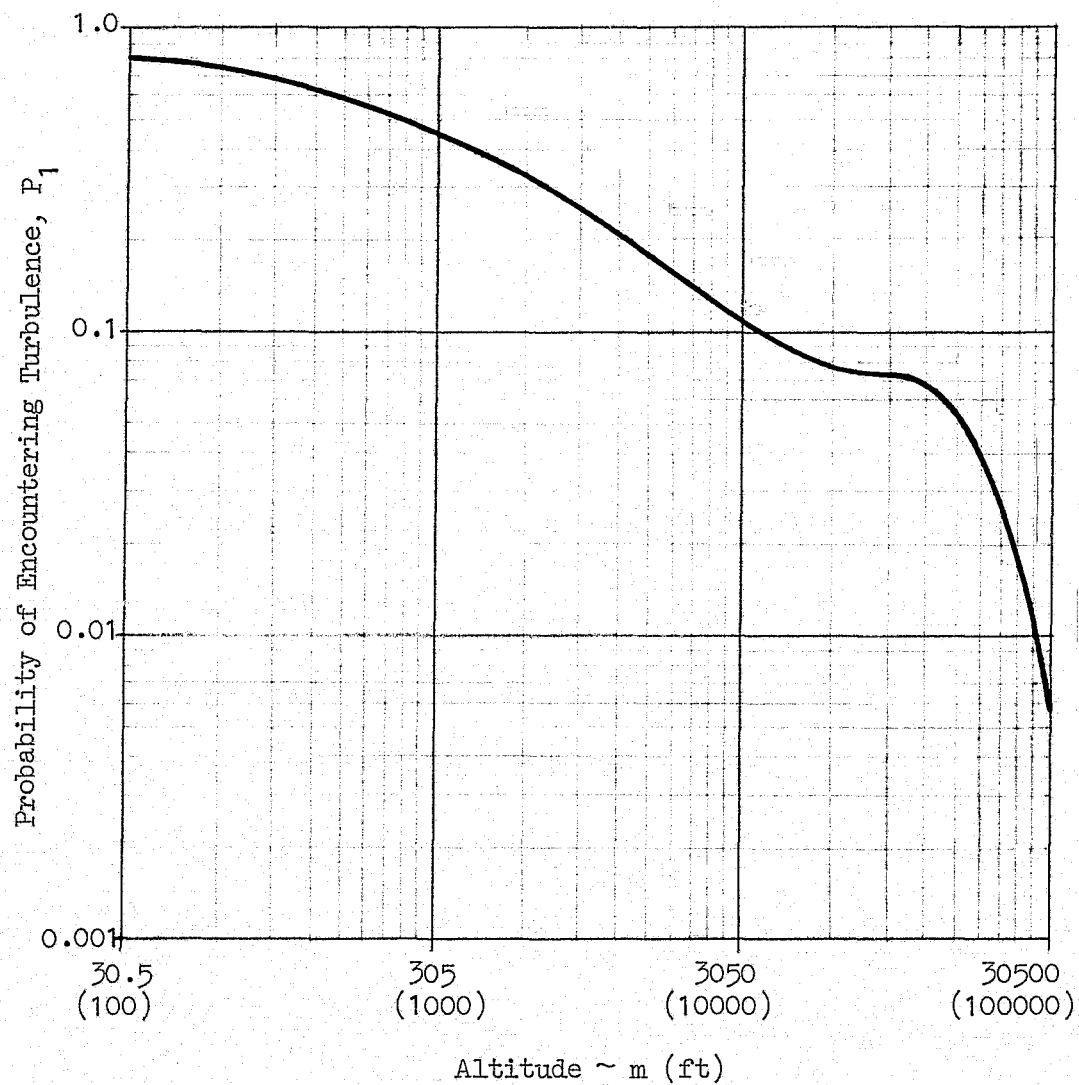


Figure II-1: Probability of Encountering Turbulence  
(Adapted from Reference 2)

## 2. Scaling the RMS Response

As mentioned above, all data in this report are for a probability of exceedance of 1% ( $P = 0.01$ ). However, because all RMS responses vary linearly with  $\sigma_u$  (which is a function of  $P$  and  $h$ ), it is a simple procedure to scale the results contained herein for any desired value of  $P$ . The proper scale factor (SF) can be derived from Equation II-1. The result is:

$$SF \triangleq \frac{\sigma(P)}{\sigma(P = 0.01)} = \sqrt{\frac{\ln(P_1/P)}{\ln(100 P_1)}} \quad \text{II-7}$$

where  $P_1$  is obtained from Figure II-1.

For convenience, Equation II-7 is plotted in Figure II-2 for a few key values of  $h_0$ .

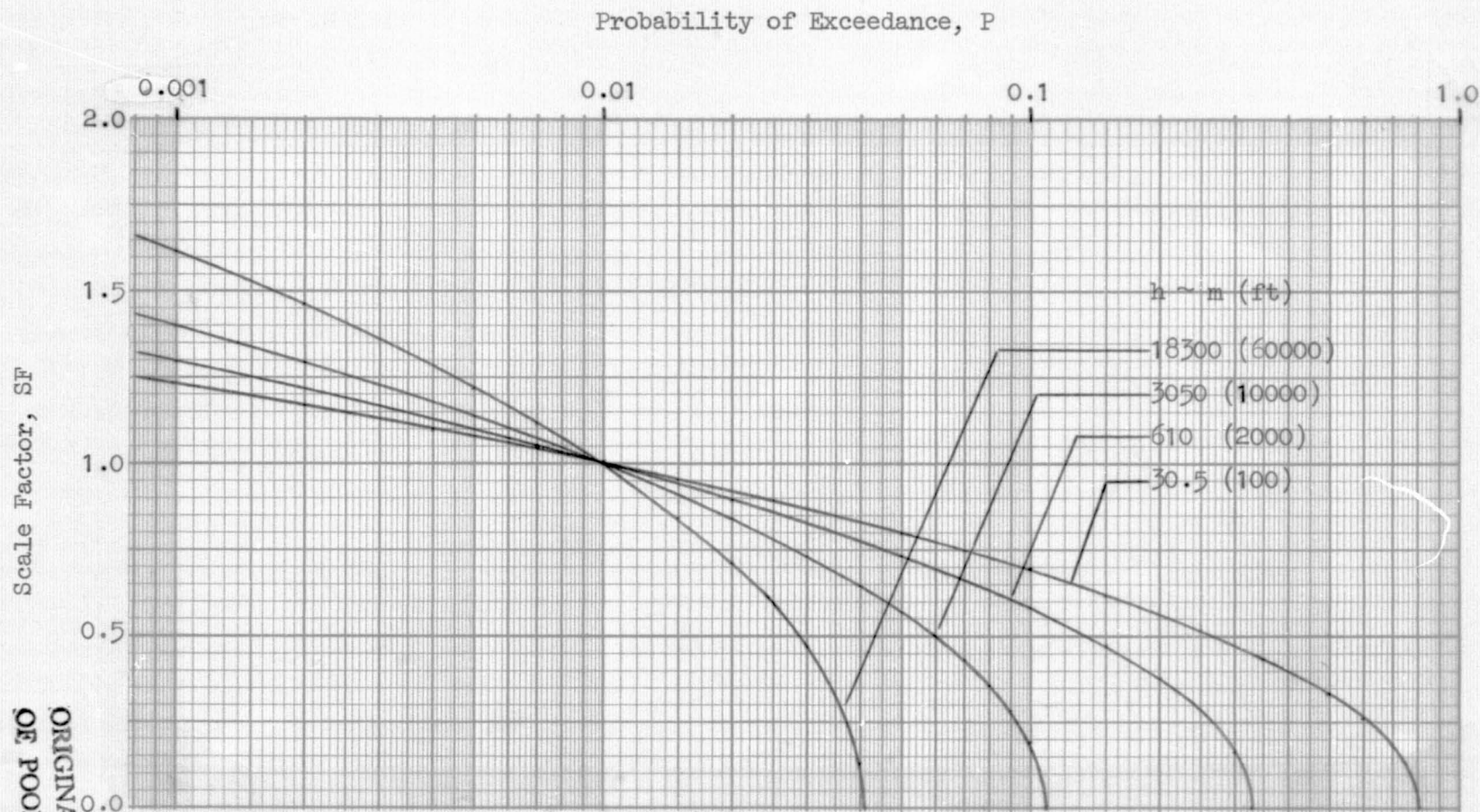
## D. WIND SHEAR

The aircraft's peak response to a discrete wind shear with and without motion washout filters was computed for both the longitudinal and lateral-directional cases. This was accomplished by saving the sign and maximum absolute value of each aircraft state. The search included the time from shear onset to 40 seconds after the shear ceased.

For the longitudinal cases an increasing tail wind was used. For the lateral-directional cases an increasing wind from the left side was used. In all cases the wind shear was 1 kt/sec and lasted for 10 seconds.

The peak response was computed for all aircraft states except the linear positions without washout filters ( $x_p$ ,  $y_p$ ,  $h_p$ ). These were excluded because their responses are unbounded.

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- Notes: 1. See Equation II-7 for an explicit expression of SF as a function of P and  $P_1$ .
2.  $P_1$  is plotted versus h in Figure II-1.

Figure II-2: Turbulence Scale Factor Versus Probability of Exceedance for Constant Values of Altitude

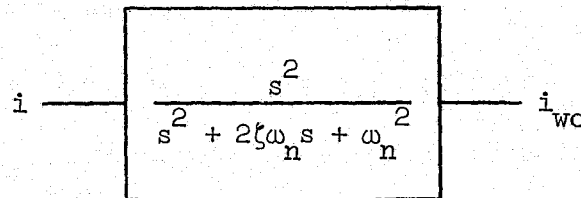
## E. WASHOUT LOGIC

The underlying purpose of most simulator motion logic is to reduce the motions of the simulator such that the physical limits of the simulator are not exceeded. This is usually accomplished by the use of scale factors and/or washout filters.

The effect of scale factors on simulator motion fidelity (i.e., simulated versus actual aircraft motion) are easy to account for. However, the effect of washout filters are not. Thus the task of choosing the type of washout filter (and its associated parameters) best suited for a particular combination of aircraft and mission is very nebulous. In fact, the choice of the washout filter parameters has been described as an "organized art".

For the purposes of this study, though, it was decided to choose the following washout filter and parameters:

1. A second order washout filter,



2. A typical damping ratio,  $\zeta = 0.7$
3. A reasonable upper limit of the break frequency,  
 $\omega_n = 1.0 \text{ rad/sec.}$

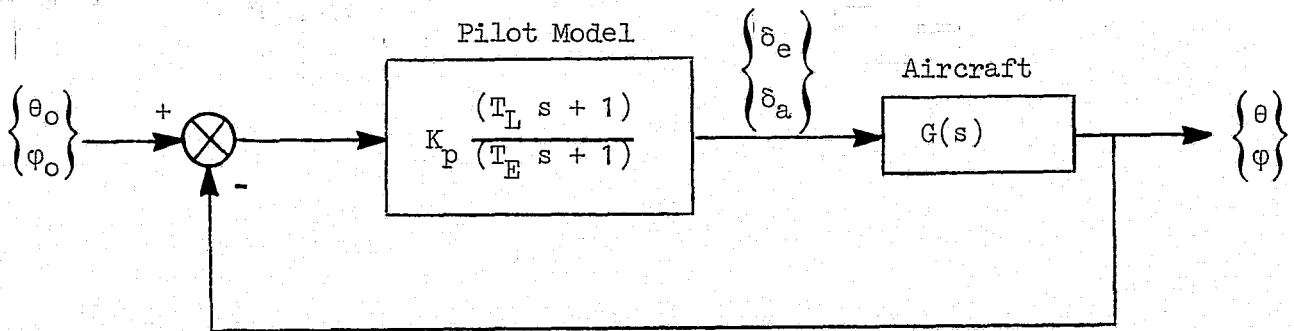
The large value of  $\omega_n$  was used to demonstrate the maximum effects of a washout filter on the resulting simulator motions.

The above described washout filter was applied to all the linear and angular positions, velocities, and accelerations of the aircraft. Note that the washed-out responses of the linear positions to atmospheric turbulence and discrete wind shears all have finite values (the unwashed-out values are unbounded).

## F. PILOT MODEL

Pilot models were used to stabilize pitch and roll attitudes. This prevents the phugoid or spiral modes from dominating the effects of external disturbances, and thus provides a more realistic evaluation of aircraft motions.

Both pilot models were identical and of the form shown below.



The pilot lag term,  $T_E$ , was set to 0.333 sec for all cases. The pilot lead term,  $T_L$ , was adjusted such that the phase margin would be at least 45 deg at a crossover frequency of 1.5 rad/sec. The pilot gain,  $K_p$ , was set to provide a crossover frequency of 1.5 rad/sec. Mathematically,  $T_L$  and  $K_p$  can be computed from:

If  $\angle G(j 1.5) \geq -108.4$  deg  
(i.e., airplane plus pilot  
lag = 135 deg)

$$T_L = 0$$

$$K_p = \frac{\sqrt{5}}{2 |G(j 1.5)|}$$

If  $\angle G(j 1.5) < -108.4$  deg

$$T_L = \frac{1}{1.5} \tan \left[ -108.4 - \angle G(j 1.5) \right]$$

$$K_p = \frac{\sqrt{5} \cos \left[ -108.4 - \angle G(j 1.5) \right]}{2 |G(j 1.5)|}$$

where  $\angle G(j 1.5)$  = Phase of  $\theta/\delta_e$  or  $\phi/\delta_a$  at  $\omega = 1.5$  rad/sec

$|G(j 1.5)|$  = Magnitude of  $\theta/\delta_e$  or  $\phi/\delta_a$  at  $\omega = 1.5$  rad/sec

and the factor of  $\sqrt{5}/2$  accounts for the magnitude of the pilot lag term at  $s = 1.5 j$

### SECTION III

#### DESCRIPTIONS OF AIRCRAFT AND FLIGHT CONDITIONS

##### A. GENERAL DESCRIPTIONS OF AIRCRAFT

The 10 aircraft selected fall into the following general categories:

- 2 Light-weight, powered-lift STOL
- 2 Medium-weight, powered-lift STOL
- 1 Light-weight, non-powered-lift STOL
- 1 Medium-weight, conventional jet transport
- 1 Heavy-weight, conventional jet transport
- 1 Large supersonic bomber
- 1 Heavy-weight helicopter
- 1 Light-weight helicopter

Brief descriptions of each aircraft are contained in the following subsections. The data sources for each aircraft are also given.

##### 1. AWJSRA

The NASA Augmentor Wing Jet STOL Research Aircraft is a light-weight powered-lift STOL aircraft modified from a de Havilland C-8A Buffalo. The flight conditions evaluated are:

- a. Approach at an altitude of 30.5 m (100 ft)
- b. Approach at an altitude of 610 m (2000 ft)

The data source used was Reference 4.

##### 2. BR 941S

The Breguet 941S is a light-weight deflected slipstream powered-lift STOL aircraft. The flight conditions evaluated are:



- a. Approach at an altitude of 30.5 m (100 ft)
- b. Takeoff at an altitude of 30.5 m (100 ft)

The data source used was Reference 5.

### 3. STOL-X

The STOL-X is a medium-weight powered-lift STOL aircraft model developed for an FAA/NASA simulation investigation of STOL airworthiness criteria, and intended as a generic model representative of powered-lift STOL aircraft. The flight condition evaluated is approach at an altitude of 30.5 m (100 ft). The data source used was Reference 6.

### 4. AMST

The so-called "AMST" is a model of a medium-weight powered-lift STOL aircraft and is representative of the Advanced Medium STOL Transport being developed by the U.S. Air Force. The flight condition evaluated is approach at 30.5 m (100 ft). The data source used was Reference 7.

### 5. DHC-6

The de Havilland Twin Otter is a light-weight, non-powered-lift STOL aircraft. The flight conditions evaluated are:

- a. Approach at an altitude of 30.5 m (100 ft)
- b. Approach at an altitude of 610 m (2000 ft)
- c. Takeoff at an altitude of 30.5 m (100 ft)

The data sources used were References 8 and 9.

### 6. CV-880M

The Convair 880M is a medium-weight conventional jet transport. The flight conditions evaluated are:

- a. Approach at an altitude of 30.5 m (100 ft)
- b. Turbulence penetration at an altitude of 7010 m (23000 ft)

- c. Cruise at an altitude of 10675 m (35000 ft)

The data source used was Reference 10.

#### 7. B-747

The Boeing 747 is a heavy-weight conventional jet transport. The flight conditions evaluated are:

- a. Approach at an altitude of 30.5 m (100 ft)
- b. Approach at an altitude of 610 m (2000 ft)
- c. Takeoff at an altitude of 30.5 m (100 ft)
- d. Turbulence penetration at an altitude of 6100 m (20000 ft)
- e. Cruise at an altitude of 10675 (35000 ft)

The data sources used were References 10, 11, and 12.

#### 8. XB-70A

The XB-70A was originally designed as a weapons system with long range, supersonic cruise capabilities. It is used here to also represent a supersonic transport class of aircraft. The flight conditions evaluated are:

- a. Approach at an altitude of 30.5 m (100 ft)
- b. Approach at an altitude of 610 m (2000 ft)
- c. Subsonic cruise at an altitude of 12190 m (40000 ft)
- d. Supersonic cruise at an altitude of 18300 m (60000 ft)

The data source used was Reference 10.

#### 9. CH-53A

The CH-53A is a heavy-weight, single rotor transport helicopter. The flight conditions evaluated are:

- a. Approach at an altitude of 30.5 m (100 ft)

- b. Approach at an altitude of 610 m (2000 ft)
- c. Hover\* at an altitude of 30.5 m (100 ft)
- d. Cruise at an altitude of 30.5 m (100 ft)

The data source used was Reference 13.

#### 10. H-19

The H-19 is a light-weight, single rotor helicopter. The flight conditions evaluated are:

- a. Hover\* at an altitude of 30.5 (100 ft)
- b. Cruise at an altitude of 30.5 m (100 ft)

The data source used was Reference 14.

#### B. GENERAL DESCRIPTIONS OF FLIGHT CONDITIONS

Brief descriptions of the aircraft/flight condition combinations selected are contained in Table III-1. These descriptions are intended to complement the purely numerical descriptions contained in Section III-C, and aid in the interpretation of the results contained in Section IV.

The parameter "aircraft" in Table III-1 is the standard designation used by the manufacturer. The "flight condition" describes the aircraft's state in terms associated with that aircraft. The parameters W, c.g., airspeed,  $\gamma_o$ ,  $\theta_o$ , and  $h_o$  are all self-explanatory. The parameter "configuration" is derived from the aircraft and flight condition by compressing the manufacturer's designation, and then adding the following code:

- A for approach
- T for takeoff

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\* The "hover" case is actually for an airspeed of 15 kt. Zero airspeed cannot be used with the turbulence model.

TABLE III-1  
FLIGHT CONDITION DESCRIPTIONS

Aircraft	AWJSRA	AWJSRA	BR 941S	BR 941S
Flight Condition	Approach 65 deg flaps 75 deg nozzles	Approach 65 deg flaps 75 deg nozzles	Approach 95 deg flaps zero trans.	Takeoff 45 deg flaps zero trans.
W ~ kg (lb)	18144 (40000)	18144 (40000)	20412 (45000)	20412 (45000)
c.g.	B.S. 341.2	B.S. 341.2	0.27 $\bar{c}$	0.27 $\bar{c}$
Airspeed ~ kt or [M]	65	65	65	75
$\gamma_o \sim \text{deg}$	-7.5	-7.5	-7.5	10.8
$\theta_o \sim \text{deg}$	-2.3	-2.3	-9.6	10.2
$h_o \sim \text{m}$ (ft)	30.5 (100)	610 (2000)	30.5 (100)	30.5 (100)
Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T

TABLE III-1 (Continued)

Aircraft	STOL-X	AMST	DHC-6	DHC-6
Flight Condition	Approach Flaps down	Approach Flaps down	Approach 40 deg flaps	Approach 40 deg flaps
W ~ kg (lb)	56699 (125000)	68040 (150000)	4990 (11000)	4990 (11000)
c.g.	0.25 $\bar{c}$	0.30 $\bar{c}$	0.22 $\bar{c}$	0.22 $\bar{c}$
Airspeed ~ kt or [M]	63.5	85	70	70
$\gamma_o \sim \text{deg}$	-6.0	-6.0	-5.4	-5.4
$\theta_o \sim \text{deg}$	-3.5	0.1	-10.5	-10.5
$h_o \sim \text{m}$ (ft)	30.5 (100)	30.5 (100)	30.5 (100)	610 (2000)
Configuration	STOLX-A	AMST-A	DHC6-A1	DHC6-A2

TABLE III-1 (Continued)

Aircraft	DHC-6	CV-880M	CV-880M	CV-880M
Flight Condition	Takeoff 20 deg flaps	Approach 50 deg flaps	Penetration Clean	Cruise Clean
W ~ kg (lb)	5253 (11580)	57153 (126000)	70307 (155000)	70307 (155000)
c.g.	0.22 $\bar{c}$	0.195 $\bar{c}$	0.25 $\bar{c}$	0.25 $\bar{c}$
Airspeed ~ kt or [M]	80	134	[0.60]	[0.86]
$\gamma_o$ ~ deg	8.8	-3.0	0.0	0.0
$\theta_o$ ~ deg	6.2	2.2	5.3	4.0
$h_o$ ~ m (ft)	30.5 (100)	30.5 (100)	7010 (23000)	10670 (35000)
Configuration	DHC6-T	CV880-A	CV880-P	CV880-C

TABLE III-1 (Continued)

Aircraft	B-747	B-747	B-747	B-747
Flight Condition	Approach 30 deg flaps	Approach 30 deg flaps	Takeoff 10 deg flaps	Penetration Clean
W ~ kg (lb)	258552 (570000)	258552 (570000)	332489 (733000)	288773 (636600)
c.g.	0.25 $\bar{c}$	0.25 $\bar{c}$	0.25 $\bar{c}$	0.25 $\bar{c}$
Airspeed ~ kt or [M]	142	142	173	[0.65]
$\gamma_o$ ~ deg	-3.0	-3.0	2.5	0.0
$\theta_o$ ~ deg	1.4	1.4	12.5	2.5
$h_o$ ~ m (ft)	30.5 (100)	610 (2000)	30.5 (100)	6100 (20000)
Configuration	B747-A1	B747-A2	B747-T	B747-P

TABLE III-1 (Continued)

Aircraft	B-747	XB-70A	XB-70A	XB-70A
Flight Condition	Cruise Clean	Approach Tips Extended	Approach Tips Extended	Subsonic Cruise Clean
W ~ kg (lb)	288773 (636600)	136077 (300000)	136077 (300000)	174417 (384524)
c.g.	0.25 $\bar{c}$	0.235 $\bar{c}$	0.235 $\bar{c}$	0.218 $\bar{c}$
Airspeed ~ kt or [M]	[0.88]	205	205	[0.90]
$\gamma_o \sim \text{deg}$	0.0	-3.0	-3.0	0.0
$\theta_o \sim \text{deg}$	1.7	4.5	4.5	7.5
$h_o \sim \text{m}$ (ft)	10670 (35000)	30.5 (100)	610 (2000)	12190 (40000)
Configuration	B747-C	XB70A-A1	XB70A-A2	XB70A-C1



TABLE III-1 (Continued)

Aircraft	XB-70A	CH-53A	CH-53A	CH-53A
Flight Condition	Supersonic Cruise Clean	Approach	Approach	"Hover"
W ~ kg (lb)	174417 (384524)	15195 (33500)	15195 (33500)	15195 (33500)
c.g.	0.218 $\bar{c}$	F.S. 352	F.S. 352	F.S. 352
Airspeed ~ kt or [M]	[2.5]	60	60	15
$\gamma_o \sim \text{deg}$	0.0	0.0	0.0	0.0
$\theta_o \sim \text{deg}$	4.4	---	---	---
$h_o \sim \text{m}$ (ft)	18290 (60000)	30.5 (100)	610 (2000)	30.5 (100)
Configuration	XB70A-C2	CH53A-A1	CH53A-A2	CH53A-H

TABLE III-1 (Concluded)

Aircraft	CH-53A	H-19	H-19
Flight Condition	Cruise	"Hover"	Cruise
W ~ kg (lb)	15195 (33500)	2902 (6400)	3175 (7000)
c.g.	F.S. 352	---	---
Airspeed ~ kt or [M]	150	15	69
$\gamma_o \sim \text{deg}$	0.0	0.0	0.0
$\theta_o \sim \text{deg}$	---	---	---
$h_o \sim \text{m}$ (ft)	30.5 (100)	30.5 (100)	30.5 (100)
Configuration	CH53A-C	H19-H	H19-C

- C for cruise
- P for turbulence penetration
- H for hover

Any parameters that are either unknown or not appropriate are indicated by a dash (---).

There are five configurations described in Table III-1 that are simply variations in altitude for aircraft in the approach configuration (e.g., AWJSRA-A1 and AWJSRA-A2). These cases are intended to demonstrate the altitude effects of the atmospheric turbulence model on the resulting RMS responses. The peak responses to the discrete wind shear for these cases will, of course, be identical.

#### C. NUMERICAL DESCRIPTION OF FLIGHT CONDITIONS

Numerical descriptions of the flight conditions for all configurations evaluated are contained in Tables III-2 through III-5. Tables III-4 and III-5 are the S.I. unit equivalents of Tables III-2 and III-3, respectively.

Table III-2 contains parameters associated with the longitudinal equations of motion. Table III-3 contains parameters associated with the lateral-directional equations of motion. The information contained in these tables can be classified as follows:

1. Trim conditions
2. Geometry
3. Stability derivatives
4. Pilot model parameters
5. Atmospheric turbulence model parameters.

TABLE III-2

TRIM CONDITIONS AND STABILITY DERIVATIVES. LONGITUDINAL, U.S. UNITS

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$V_{T_0} \sim \text{ft/sec}$	109.7	109.7	109.7	126.7	107.2	143.6
$h_0 \sim \text{ft}$	100.0	2000.	100.0	100.0	100.0	100.0
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	5.19	5.19	-2.07	-.630	2.54	6.10
$\gamma_0 \sim \text{deg}$	-7.50	-7.50	-7.50	10.80	-6.0	-6.0
$l_x \sim \text{ft}$	18.80	18.80	21.0	21.0	43.0	40.0
$b \sim \text{ft}$	78.8	78.8	76.8	76.8	111.4	110.3
$X_u \sim 1/\text{sec}$	-.0680	-.0680	-.1190	-.0465	-.1178	-.0779
$Z_u \sim 1/\text{sec}$	-.281	-.281	-.397	-.288	-.419	-.316
$M_u \sim 1/\text{sec-ft}$	-.000350	-.000350	.001596	.00303	-.0001660	-.0001552
$Z_w \sim 1/1$	-.0130	-.0130	-.01250	-.01250	-.00644	-.00631
$M_w \sim 1/\text{ft}$	-.00374	-.00374	-.00281	-.00278	-.000838	-.000987
$X_w \sim 1/\text{sec}$	.1360	.1360	.1290	.1510	.0905	.0742
$Z_w \sim 1/\text{sec}$	-.505	-.505	-.557	-.908	-.422	-.430
$M_w \sim 1/\text{sec-ft}$	-.00450	-.00450	-.00396	-.00315	-.00256	-.00383
$X_q \sim \text{ft/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_q \sim \text{ft/sec}$	0.0	0.0	-3.60	-4.16	-4.64	0.0
$M_q \sim 1/\text{sec}$	-1.080	-1.080	-.807	-.921	-.494	-.779
$X_{\delta_e} \sim \text{ft/sec}^2$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_{\delta_e} \sim \text{ft/sec}^2$	3.51	3.51	4.57	4.63	9.25	8.43
$M_{\delta_e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	3.20	3.20	2.58	2.84	1.746	2.28
$T_L \sim \text{sec}$	.269	.269	.40	.403	.699	.399
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_u \sim \text{ft/sec}$	6.82	6.08	6.82	6.82	6.82	6.82
$\sigma_w \sim \text{ft/sec}$	2.63	6.08	2.63	2.63	2.63	2.63
$L_u \sim \text{ft}$	673.	1750.	673.	673.	673.	673.
$L_w \sim \text{ft}$	100.0	1750.	100.0	100.0	100.0	100.0

TABLE III-2 (Continued)

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Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$V_{T_0} \sim \text{ft/sec}$	118.2	118.2	135.1	226.	615.	837.
$h_0 \sim \text{ft}$	100.0	2000.	100.0	100.0	23000.	35000.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	-5.10	-5.10	-2.59	5.20	5.30	4.04
$\gamma_0 \sim \text{deg}$	-5.40	-5.40	8.78	-3.0	0.0	0.0
$l_x \sim \text{ft}$	9.75	9.75	9.75	49.2	49.2	49.2
$b \sim \text{ft}$	65.0	65.0	65.0	120.0	120.0	120.0
$X_u \sim 1/\text{sec}$	-.0678	-.0678	-.0646	-.0423	-.00642	-.00590
$Z_u \sim 1/\text{sec}$	-.524	-.524	-.383	-.284	-.1050	-.0772
$M_u \sim 1/\text{sec-ft}$	.001050	.001050	.00515	-.0001372	-.249E-4	-.227E-4
$Z_w \sim 1/1$	-.0389	-.0389	-.01271	-.01550	-.00550	-.00420
$M_w \sim 1/\text{ft}$	-.00270	-.00270	-.00459	-.000726	-.000340	-.000243
$X_w \sim 1/\text{sec}$	.1840	.1840	.0629	.0828	.0321	.0219
$Z_w \sim 1/\text{sec}$	-.930	-.930	-1.504	-.661	-.628	-.631
$M_w \sim 1/\text{sec-ft}$	-.0245	-.0245	-.01191	-.001580	-.00277	-.00345
$X_q \sim \text{ft/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_q \sim \text{ft/sec}$	0.0	0.0	0.0	-10.40	-9.34	-9.25
$M_q \sim 1/\text{sec}$	-1.750	-1.750	-1.332	-.481	-.578	-.530
$X_{\delta_e} \sim \text{ft/sec}^2$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_{\delta_e} \sim \text{ft/sec}^2$	2.83	2.83	2.79	11.30	9.23	9.39
$M_{\delta_e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$X_\theta \sim 1/1$	4.77	4.77	4.08	2.99	2.18	2.35
$T_L \sim \text{sec}$	0.0	0.0	.1597	.643	.1064	0.0
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_u \sim \text{ft/sec}$	6.82	6.08	6.82	6.62	4.64	4.55
$\sigma_w \sim \text{ft/sec}$	2.63	6.08	2.63	2.63	4.64	4.55
$L_u \sim \text{ft}$	673.	1750.	673.	673.	1750.	1750.
$L_w \sim \text{ft}$	100.0	1750.	100.0	100.0	1750.	1750.

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TABLE III-2 (Continued)

Configuration	B747-A1	B747-A2	B747-T	3747-P	B747-C
$V_{T_0} \sim \text{ft/sec}$	241.	241.	292.	674.	856.
$h_0 \sim \text{ft}$	100.0	2000.	100.0	20000.	35000.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	4.44	4.44	10.0	2.50	1.70
$\gamma_0 \sim \text{deg}$	-3.0	-3.0	2.50	0.0	0.0
$l_x \sim \text{ft}$	86.0	86.0	86.0	86.0	86.0
$b \sim \text{ft}$	195.7	195.7	195.7	195.7	195.7
$X_u \sim 1/\text{sec}$	-.0335	-.0335	-.0209	-.00534	-.0284
$Z_u \sim 1/\text{sec}$	-.265	-.265	-.213	-.1070	-.0321
$M_u \sim 1/\text{sec-ft}$	-.0001074	-.0001074	-.000201	.574E-5	-.000306
$Z_w \sim 1/1$	-.0338	-.0338	-.0263	-.01560	-.00785
$M_w \sim 1/\text{ft}$	-.000241	-.000241	-.000218	-.0001550	-.0001830
$X_w \sim 1/\text{sec}$	.0492	.0492	.0314	.0249	-.001472
$Z_w \sim 1/\text{sec}$	-.521	-.521	-.472	-.537	-.468
$M_w \sim 1/\text{sec-ft}$	-.00206	-.00206	-.00224	-.00190	-.001841
$X_q \sim \text{ft/sec}$	0.0	0.0	0.0	0.0	0.0
$Z_q \sim \text{ft/sec}$	-6.67	-6.67	-6.19	-8.11	-7.70
$M_q \sim 1/\text{sec}$	-.385	-.385	-.413	-.535	-.474
$X_{\delta_e} \sim \text{ft/sec}^2$	0.0	0.0	0.0	0.0	0.0
$Z_{\delta_e} \sim \text{ft/sec}^2$	16.95	16.95	14.40	15.62	15.56
$M_{\delta_e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	1.545	1.545	1.581	1.860	1.793
$T_L \sim \text{sec}$	.719	.719	.621	.270	.1609
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333
$\sigma_u \sim \text{ft/sec}$	6.82	6.08	6.82	4.66	4.55
$\sigma_w \sim \text{ft/sec}$	2.63	6.08	2.63	4.66	4.55
$L_u \sim \text{ft}$	673.	1750.	673.	1750.	1750.
$L_w \sim \text{ft}$	100.0	1750.	100.0	1750.	1750.

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TABLE III-2 (Continued)

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$V_{T_0} \sim \text{ft/sec}$	346.	346.	871.	2420.
$h_0 \sim \text{ft}$	100.0	2000.	40000.	60000.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	7.50	7.50	7.50	4.40
$\gamma_0 \sim \text{deg}$	-3.0	-3.0	0.0	0.0
$l_x \sim \text{ft}$	99.0	99.0	97.7	97.7
$b \sim \text{ft}$	105.0	105.0	105.0	105.0
$X_u \sim 1/\text{sec}$	-.0306	-.0306	-.00865	-.00323
$Z_u \sim 1/\text{sec}$	-.1850	-.1850	-.0888	-.0170
$M_u \sim 1/\text{sec-ft}$	-.395E-4	-.395E-4	-.000528	-.380E-4
$Z_w \sim 1/1$	0.0	0.0	0.0	0.0
$M_w \sim 1/\text{ft}$	.721E-4	.721E-4	.290E-4	0.0
$X_w \sim 1/\text{sec}$	-.0630	-.0630	-.0419	-.00577
$Z_w \sim 1/\text{sec}$	-.737	-.737	-.369	-.204
$M_w \sim 1/\text{sec-ft}$	-.00292	-.00292	-.001530	-.000810
$X_q \sim \text{ft/sec}$	0.0	0.0	0.0	0.0
$Z_q \sim \text{ft/sec}$	0.0	0.0	0.0	0.0
$M_q \sim 1/\text{sec}$	-.749	-.749	-.653	-.1070
$X_{\delta_e} \sim \text{ft/sec}^2$	0.0	0.0	0.0	0.0
$Z_{\delta_e} \sim \text{ft/sec}^2$	52.9	52.9	33.1	15.85
$M_{\delta_e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	2.23	2.23	1.734	.567
$T_L \sim \text{sec}$	.249	.249	.211	.218
$T_E \sim \text{sec}$	.333	.333	.333	.333
$\sigma_u \sim \text{ft/sec}$	6.82	6.08	4.52	3.86
$\sigma_w \sim \text{ft/sec}$	2.63	6.08	4.52	3.86
$L_u \sim \text{ft}$	673.	1750.	1750.	1750.
$L_w \sim \text{ft}$	100.0	1750.	1750.	1750.

TABLE III-2 (Concluded)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$V_{T_0} \sim \text{ft/sec}$	101.0	101.0	25.3	253.	25.3	116.4
$h_0 \sim \text{ft}$	100.0	2000.	100.0	100.0	100.0	100.0
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\gamma_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$l_x \sim \text{ft}$	17.0	17.0	17.0	17.0	2.40	2.40
$b \sim \text{ft}$	72.3	72.3	72.3	72.3	53.0	53.0
$X_u \sim 1/\text{sec}$	-.0227	-.0227	-.01540	-.0396	-.0284	-.0525
$Z_u \sim 1/\text{sec}$	-.0893	-.0893	0.0	.0733	0.0	.01510
$M_u \sim 1/\text{sec-ft}$	.00322	.00322	.00204	.001650	.00609	.00612
$Z_w \sim 1/1$	0.0	0.0	0.0	0.0	0.0	0.0
$M_w \sim 1/\text{ft}$	-.000213	-.000213	0.0	-.0001120	0.0	0.0
$X_w \sim 1/\text{sec}$	-.000528	-.000528	0.0	.0301	0.0	.0207
$Z_w \sim 1/\text{sec}$	-.694	-.694	-.303	-1.060	-.690	-.810
$M_w \sim 1/\text{sec-ft}$	.001695	.001695	.000746	.00702	0.0	-.00231
$X_q \sim \text{ft/sec}$	1.690	1.690	1.360	.790	2.73	3.81
$Z_q \sim \text{ft/sec}$	.0954	.0954	.1260	.1620	0.0	-.40
$M_q \sim 1/\text{sec}$	-.562	-.562	-.438	-.724	-.610	-1.004
$X_{\delta_e} \sim \text{ft/sec}^2$	-7.10	-7.10	-7.69	-4.02	-4.84	-4.31
$Z_{\delta_e} \sim \text{ft/sec}^2$	-14.79	-14.79	0.0	-39.4	0.0	-12.96
$M_{\delta_e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	1.706	1.706	1.469	2.11	1.669	2.29
$T_L \sim \text{sec}$	.877	.877	.987	1.135	.828	.472
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_u \sim \text{ft/sec}$	6.82	6.08	6.82	6.82	6.82	6.82
$\sigma_w \sim \text{ft/sec}$	2.63	6.08	2.63	2.63	2.63	2.63
$L_u \sim \text{ft}$	673.	1750.	673.	673.	673.	673.
$L_w \sim \text{ft}$	100.0	1750.	100.0	100.0	100.0	100.0



TABLE III-3

TRIM CONDITIONS AND STABILITY DERIVATIVES. LATERAL-DIRECTIONAL, U.S. UNITS

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$V_{T_0} \sim \text{ft/sec}$	109.7	109.7	109.7	126.7	107.2	143.6
$h_0 \sim \text{ft}$	100.0	2000.	100.0	100.0	100.0	100.0
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	5.19	5.19	-2.07	-.630	2.54	6.10
$\gamma_0 \sim \text{deg}$	-7.50	-7.50	-7.50	10.80	-6.0	-6.0
$l_x \sim \text{ft}$	18.80	18.80	21.0	21.0	43.0	40.0
$l_z \sim \text{ft}$	-1.240	-1.240	0.0	0.0	0.0	0.0
$b \sim \text{ft}$	78.8	78.8	76.8	76.8	111.4	110.3
$Y_v \sim 1/\text{sec}$	-.1240	-.1240	-.1140	-.1610	-.0765	-.0851
$Y_p \sim \text{ft/sec}$	0.0	0.0	0.0	0.0	.975	0.0
$Y_r \sim \text{ft/sec}$	0.0	0.0	0.0	0.0	.474	0.0
$L'_p \sim 1/\text{sec}^2$	.0403	.0403	-.206	-.805	-.505	-.875
$L'_p \sim 1/\text{sec}$	-.624	-.624	-.786	-.704	-.625	-.750
$L'_r \sim 1/\text{sec}$	1.567	1.567	-.0970	.749	.980	1.364
$N'_\beta \sim 1/\text{sec}^2$	.534	.534	.554	.0706	.1788	.377
$N'_p \sim 1/\text{sec}$	-.232	-.232	-.1150	-.1560	-.140	-.199
$N'_r \sim 1/\text{sec}$	-.238	-.238	-.490	-.428	-.0735	-.1660
$Y_{\delta_a}^* \sim 1/\text{sec}$	-.0239	-.0239	0.0	0.0	0.0	0.0
$L'_{\delta_a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$N'_{\delta_a} \sim 1/\text{sec}^2$	-.1476	-.1476	.00190	-.01890	.0778	.0350
$K_\phi \sim 1/1$	1.928	1.928	1.914	1.744	1.466	1.508
$T_L \sim \text{sec}$	.375	.375	.702	.709	.937	.769
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_v \sim \text{ft/sec}$	6.82	6.08	6.82	6.82	6.82	6.82
$\sigma_p \sim \text{deg/sec}$	1.684	1.502	1.714	1.714	1.337	1.346
$L_v \sim \text{ft}$	673.	1750.	673.	673.	673.	673.

TABLE III-3 (Continued)

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Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$V_{T_0} \sim \text{ft/sec}$	118.2	118.2	135.1	226.	615.	837.
$h_0 \sim \text{ft}$	100.0	2000.	100.0	100.0	23000.	35000.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	-5.10	-5.10	-2.59	5.20	5.30	4.04
$\gamma_0 \sim \text{deg}$	-5.40	-5.40	8.78	-3.0	0.0	0.0
$l_x \sim \text{ft}$	9.75	9.75	9.75	49.2	49.2	49.2
$l_z \sim \text{ft}$	-2.03	-2.03	-2.03	-4.15	-4.15	-4.15
$b \sim \text{ft}$	65.0	65.0	65.0	120.0	120.0	120.0
$Y_v \sim 1/\text{sec}$	-.1337	-.1337	-.1780	-.1390	-.1150	-.1080
$Y_p \sim \text{ft/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$Y_r \sim \text{ft/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$L'_\beta \sim 1/\text{sec}^2$	-2.21	-2.21	-2.95	-3.13	-5.82	-7.57
$L'_p \sim 1/\text{sec}$	-4.49	-4.49	-4.67	-1.30	-1.090	-.863
$L'_r \sim 1/\text{sec}$	2.47	2.47	2.46	1.080	.518	.450
$N'_\beta \sim 1/\text{sec}^2$	2.02	2.02	1.742	.786	1.970	2.36
$N'_p \sim 1/\text{sec}$	-.738	-.738	-.307	-.01390	.0424	.0325
$N'_r \sim 1/\text{sec}$	-.706	-.706	-.546	-.303	-.233	-.20
$Y_{\delta a}^* \sim 1/\text{sec}$	0.0	0.0	-.1223E-4	-.00960	-.00160	-.00130
$L'_{\delta a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$N'_{\delta a} \sim 1/\text{sec}^2$	.01063	.01063	.1463	.01330	-.01220	-.0218
$K_\phi \sim 1/1$	10.76	10.76	6.33	2.27	2.34	2.62
$T_L \sim \text{sec}$	0.0	0.0	0.0	.517	.411	.258
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\alpha_v \sim \text{ft/sec}$	6.82	6.08	6.82	6.82	4.64	4.55
$\alpha_p \sim \text{deg/sec}$	1.915	1.708	1.915	1.272	.865	.649
$L_v \sim \text{ft}$	673.	1750.	673.	673.	1750.	1750.

ORIGINAL PAGE IS  
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TABLE III-3 (Continued)

Configuration	B747-A1	B747-A2	B747-T	3747-P	B747-C
$V_{T0} \sim \text{ft/sec}$	241.	241.	292.	674.	856.
$h_0 \sim \text{ft}$	100.0	2000.	100.0	20000.	35000.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	4.44	4.44	10.0	2.50	1.70
$\gamma_0 \sim \text{deg}$	-3.0	-3.0	2.50	0.0	0.0
$l_x \sim \text{ft}$	86.0	86.0	86.0	86.0	86.0
$l_z \sim \text{ft}$	-10.0	-10.0	-10.0	-10.0	-10.0
$b \sim \text{ft}$	195.7	195.7	195.7	195.7	195.7
$Y_v \sim 1/\text{sec}$	-.0935	-.0935	-.0699	-.1040	-.0765
$Y_p \sim \text{ft/sec}$	5.70	5.70	4.35	0.0	0.0
$Y_r \sim \text{ft/sec}$	.207	.207	1.035	0.0	.241
$L'_p \sim 1/\text{sec}^2$	-1.321	-1.321	-1.240	-2.92	-3.06
$L'_p \sim 1/\text{sec}$	-1.016	-1.016	-.757	-.791	-.559
$L'_r \sim 1/\text{sec}$	.315	.315	.344	.344	.314
$N'_p \sim 1/\text{sec}^2$	.273	.273	.436	1.050	1.694
$N'_p \sim 1/\text{sec}$	-.0909	-.0909	-.0430	-.0270	.01092
$N'_r \sim 1/\text{sec}$	-.212	-.212	-.209	-.205	-.1738
$Y_{\delta a} \sim 1/\text{sec}$	0.0	0.0	0.0	0.0	0.0
$L'_{\delta a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00
$N'_{\delta a} \sim 1/\text{sec}^2$	.0337	.0337	-.0718	.0507	-.0443
$K_\phi \sim 1/1$	2.18	2.18	1.818	1.803	1.484
$T_L \sim \text{sec}$	.589	.589	.680	.846	.714
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333
$\alpha_v \sim \text{ft/sec}$	6.82	6.08	6.82	4.66	4.55
$\alpha_p \sim \text{deg/sec}$	.918	.819	.918	.628	.613
$L_v \sim \text{ft}$	673.	1750.	673.	1750.	1750.

TABLE III-3 (Continued)

ORIGINAL PAGE IS  
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Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$V_{T_0} \sim \text{ft/sec}$	346.	346.	871.	2420.
$h_0 \sim \text{ft}$	100.0	2000.	40000.	60000.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	7.50	7.50	7.50	4.40
$\gamma_0 \sim \text{deg}$	-3.0	-3.0	0.0	0.0
$l_x \sim \text{ft}$	99.0	99.0	97.7	97.7
$l_z \sim \text{ft}$	-6.70	-6.70	-6.70	-6.70
$b \sim \text{ft}$	105.0	105.0	105.0	105.0
$Y_v \sim 1/\text{sec}$	-.0508	-.0508	-.0352	-.0548
$Y_p \sim \text{ft/sec}$	0.0	0.0	0.0	0.0
$Y_r \sim \text{ft/sec}$	0.0	0.0	0.0	0.0
$L'_\beta \sim 1/\text{sec}^2$	-4.88	-4.88	-6.01	2.05
$L'_p \sim 1/\text{sec}$	-1.730	-1.730	-1.220	-.411
$L'_r \sim 1/\text{sec}$	-.01120	-.01120	.241	.0412
$N'_\beta \sim 1/\text{sec}^2$	1.550	1.550	1.680	.757
$N'_p \sim 1/\text{sec}$	.0451	.0451	.206	.000752
$N'_r \sim 1/\text{sec}$	-.1780	-.1780	-.1280	-.1530
$Y_{\delta_a}^* \sim 1/\text{sec}$	-.00639	-.00639	-.504E-4	0.0
$L'_{\delta_a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00
$N'_{\delta_a} \sim 1/\text{sec}^2$	-.1777	-.1777	-.1857	-.1175
$K_\phi \sim 1/l$	1.549	1.549	2.15	1.663
$T_L \sim \text{sec}$	.1833	.1833	.0533	1.049
$T_E \sim \text{sec}$	.333	.333	.333	.333
$\sigma_v \sim \text{ft/sec}$	6.82	6.08	4.52	3.86
$\alpha_p \sim \text{deg/sec}$	1.391	1.241	.922	.788
$L_v \sim \text{ft}$	673.	1750.	1750.	1750.

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OF POOR QUALITY

TABLE III-3 (Concluded)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$V_{T_O} \sim \text{ft/sec}$	101.0	101.0	25.3	253.	25.3	116.4
$h_O \sim \text{ft}$	100.0	2000.	100.0	100.0	100.0	100.0
$\alpha_O \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\gamma_O \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$l_x \sim \text{ft}$	17.0	17.0	17.0	17.0	2.70	2.70
$l_z \sim \text{ft}$	0.0	0.0	0.0	0.0	0.0	0.0
$b \sim \text{ft}$	72.3	72.3	72.3	72.3	53.0	53.0
$Y_v \sim 1/\text{sec}$	-.0867	-.0867	-.0352	-.1540	-.0731	-.1220
$Y_p \sim \text{ft/sec}$	-1.90	-1.90	-1.430	-1.240	-3.0	-5.0
$Y_r \sim \text{ft/sec}$	2.04	2.04	.850	3.23	1.420	1.30
$L'_\beta \sim 1/\text{sec}^2$	-1.141	-1.141	-.324	-5.85	-1.316	-8.47
$L'_p \sim 1/\text{sec}$	-2.0	-2.0	-2.31	-1.790	-3.18	-4.81
$L'_r \sim 1/\text{sec}$	.227	.227	.0946	.654	.804	1.00
$N'_\beta \sim 1/\text{sec}^2$	.901	.901	.1343	2.71	.891	3.78
$N'_p \sim 1/\text{sec}$	.0471	.0471	.01660	.1150	.220	.201
$N'_r \sim 1/\text{sec}$	-.553	-.553	-.232	-.842	-1.10	-1.10
$Y_{\delta_a} \sim 1/\text{sec}$	.01450	.01450	.0586	.00573	.0436	.00651
$L'_{\delta_a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$N'_{\delta_a} \sim 1/\text{sec}^2$	.00409	.00409	.00384	.00937	0.0	0.0
$K_\phi \sim 1/1$	3.69	3.69	4.18	3.25	4.72	8.14
$T_L \sim \text{sec}$	.234	.234	.1908	.303	.0685	0.0
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\alpha_v \sim \text{ft/sec}$	6.82	6.08	6.82	6.82	6.82	6.82
$\alpha_p \sim \text{deg/sec}$	1.785	1.592	1.785	1.785	2.19	2.19
$L_v \sim \text{ft}$	673.	1750.	673.	673.	673.	673.

TABLE III-4

TRIM CONDITIONS AND STABILITY DERIVATIVES. LONGITUDINAL, S.I. UNITS

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$V_{T_0} \sim \text{m/sec}$	33.4	33.4	33.4	38.6	32.7	43.6
$h_0 \sim \text{m}$	30.5	610.	30.5	30.5	30.5	30.5
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	5.19	5.19	-2.07	-.630	2.54	6.10
$\gamma_0 \sim \text{deg}$	-7.50	-7.50	-7.50	10.80	-6.0	-6.0
$l_x \sim \text{m}$	5.73	5.73	6.40	6.40	13.11	12.19
$b \sim \text{m}$	24.0	24.0	23.4	23.4	33.9	33.6
$X_u \sim 1/\text{sec}$	-.0680	-.0680	-.1190	-.0465	-.1178	-.0779
$Z_u \sim 1/\text{sec}$	-.281	-.281	-.397	-.288	-.419	-.316
$M_u \sim 1/\text{sec-m}$	-.001148	-.001148	.00524	.00994	-.000545	-.000509
$Z_w \sim 1/1$	-.0130	-.0130	-.01250	-.01250	-.00544	-.00631
$M_w \sim 1/\text{m}$	-.01227	-.01227	-.00922	-.00912	-.00275	-.00324
$X_w \sim 1/\text{sec}$	.1360	.1360	.1290	.1510	.0905	.0742
$Z_w \sim 1/\text{sec}$	-.505	-.505	-.557	-.908	-.422	-.430
$M_w \sim 1/\text{sec-m}$	-.01476	-.01476	-.01299	-.01033	-.00840	-.01256
$X_q \sim \text{m/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_q \sim \text{m/sec}$	0.0	0.0	-1.097	-1.268	-1.414	0.0
$M_q \sim 1/\text{sec}$	-1.080	-1.080	-.807	-.921	-.494	-.779
$X_{\delta e} \sim \text{m/sec}^2$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_{\delta e} \sim \text{m/sec}^2$	1.070	1.070	1.393	1.411	2.82	2.57
$M_{\delta e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	3.20	3.20	2.53	2.84	1.746	2.28
$T_L \sim \text{sec}$	.269	.269	.40	.403	.699	.399
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_u \sim \text{m/sec}$	2.08	1.854	2.08	2.08	2.08	2.08
$\sigma_w \sim \text{m/sec}$	.801	1.854	.801	.801	.801	.801
$L_u \sim \text{m}$	205.	533.	205.	205.	205.	205.
$L_w \sim \text{m}$	30.5	533.	30.5	30.5	30.5	30.5

TABLE III-4 (Continued)

ORIGINAL PAGE IS  
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Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$V_{T_0} \sim \text{m/sec}$	36.0	36.0	41.2	68.9	187.5	255.
$h_0 \sim \text{m}$	30.5	610.	30.5	30.5	7010.	10670.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	-5.10	-5.10	-2.59	5.20	5.30	4.04
$\gamma_0 \sim \text{deg}$	-5.40	-5.40	8.78	-3.0	0.0	0.0
$l_x \sim \text{m}$	2.97	2.97	2.97	15.0	15.0	15.0
$b \sim \text{m}$	19.81	19.81	19.81	36.6	36.6	36.6
$X_u \sim 1/\text{sec}$	-.0678	-.0678	-.0646	-.0423	-.00642	-.00590
$Z_u \sim 1/\text{sec}$	-.524	-.524	-.383	-.284	-.1050	-.0772
$M_u \sim 1/\text{sec-m}$	.00344	.00344	.01690	-.000450	-.817E-4	-.745E-4
$Z_w \sim 1/1$	-.0389	-.0389	-.01271	-.01550	-.00550	-.00420
$M_w \sim 1/\text{m}$	-.00886	-.00886	-.01505	-.00238	-.001116	-.000796
$X_w \sim 1/\text{sec}$	.1840	.1840	.0629	.0828	.0321	.0219
$Z_w \sim 1/\text{sec}$	-.930	-.930	-1.504	-.661	-.628	-.631
$M_w \sim 1/\text{sec-m}$	-.0804	-.0804	-.0391	-.00518	-.00909	-.01133
$X_q \sim \text{m/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_q \sim \text{m/sec}$	0.0	0.0	0.0	-3.17	-2.85	-2.82
$M_q \sim 1/\text{sec}$	-1.750	-1.750	-1.332	-.481	-.578	-.530
$X_{\delta_e} \sim \text{m/sec}^2$	0.0	0.0	0.0	0.0	0.0	0.0
$Z_{\delta_e} \sim \text{m/sec}^2$	.863	.863	.850	3.44	2.81	2.86
$M_{\delta_e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	4.77	4.77	4.08	2.99	2.18	2.35
$T_L \sim \text{sec}$	0.0	0.0	.1597	.643	.1064	0.0
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_u \sim \text{m/sec}$	2.08	1.854	2.08	2.08	1.413	1.387
$\sigma_w \sim \text{m/sec}$	.801	1.854	.801	.801	1.413	1.387
$L_u \sim \text{m}$	205.	533.	205.	205.	533.	533.
$L_w \sim \text{m}$	30.5	533.	30.5	30.5	533.	533.

ORIGINAL PAGE IS  
OF POOR QUALITY

TABLE III-4 (Continued)

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$V_{T_0} \sim \text{m/sec}$	73.3	73.3	89.1	205.	261.
$h_o \sim \text{m}$	30.5	610.	30.5	6100.	10670.
$\alpha_o \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	4.44	4.44	10.0	2.50	1.70
$\gamma_o \sim \text{deg}$	-3.0	-3.0	2.50	0.0	0.0
$l_x \sim \text{m}$	26.2	26.2	26.2	26.2	26.2
$b \sim \text{m}$	59.6	59.6	59.6	59.6	59.6
$X_u \sim 1/\text{sec}$	-.0335	-.0335	-.0209	-.00534	-.0284
$Z_u \sim 1/\text{sec}$	-.265	-.265	-.213	-.1070	-.0321
$M_u \sim 1/\text{sec-m}$	-.000352	-.000352	-.000659	.1883E-4	-.001003
$Z_w \sim 1/1$	-.0338	-.0338	-.0263	-.01560	-.00785
$M_w \sim 1/\text{m}$	-.000790	-.000790	-.000716	-.000509	-.00060
$X_w \sim 1/\text{sec}$	.0492	.0492	.0314	.0249	-.001472
$Z_w \sim 1/\text{sec}$	-.521	-.521	-.472	-.537	-.468
$M_w \sim 1/\text{sec-m}$	-.00677	-.00677	-.00734	-.00623	-.00604
$X_q \sim \text{m/sec}$	0.0	0.0	0.0	0.0	0.0
$Z_q \sim \text{m/sec}$	-2.03	-2.03	-1.887	-2.47	-2.35
$M_q \sim 1/\text{sec}$	-.385	-.385	-.413	-.535	-.474
$X_{\delta e} \sim \text{m/sec}^2$	0.0	0.0	0.0	0.0	0.0
$Z_{\delta e} \sim \text{m/sec}^2$	5.17	5.17	4.39	4.76	4.74
$M_{\delta e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	1.545	1.545	1.581	1.860	1.793
$T_L \sim \text{sec}$	.719	.719	.621	.270	.1609
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333
$\sigma_u \sim \text{m/sec}$	2.08	1.854	2.08	1.421	1.387
$\sigma_w \sim \text{m/sec}$	.801	1.854	.801	1.421	1.387
$L_u \sim \text{m}$	205.	533.	205.	533.	533.
$L_w \sim \text{m}$	30.5	533.	30.5	533.	533.



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TABLE III-4 (Continued)

Configuration	X870A-A1	X870A-A2	X870A-C1	X370A-C2
$V_{T_0} \sim \text{m/sec}$	105.5	105.5	265.	738.
$h_0 \sim \text{m}$	30.5	610.	12190.	18290.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	7.50	7.50	7.50	4.40
$\gamma_0 \sim \text{deg}$	-3.0	-3.0	0.0	0.0
$f_x \sim \text{m}$	30.2	30.2	29.8	29.8
$b \sim \text{m}$	32.0	32.0	32.0	32.0
$X_u \sim 1/\text{sec}$	-.0306	-.0306	-.00865	-.00323
$Z_u \sim 1/\text{sec}$	-.1850	-.1850	-.0888	-.0170
$M_u \sim 1/\text{sec-m}$	-.0001296	-.0001296	-.001732	-.0001247
$Z_w \sim 1/1$	0.0	0.0	0.0	0.0
$M_w \sim 1/\text{m}$	.000237	.000237	.951E-4	0.0
$X_w \sim 1/\text{sec}$	-.0630	-.0630	-.0419	-.00577
$Z_w \sim 1/\text{sec}$	-.737	-.737	-.369	-.204
$M_w \sim 1/\text{sec-m}$	-.00958	-.00958	-.00502	-.00266
$X_q \sim \text{m/sec}$	0.0	0.0	0.0	0.0
$Z_q \sim \text{m/sec}$	0.0	0.0	0.0	0.0
$M_q \sim 1/\text{sec}$	-.749	-.749	-.653	-.1070
$X_{\delta e} \sim \text{m/sec}^2$	0.0	0.0	0.0	0.0
$Z_{\delta e} \sim \text{m/sec}^2$	16.12	16.12	10.10	4.83
$M_{\delta e} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	2.23	2.23	1.734	.567
$T_L \sim \text{sec}$	.249	.249	.211	.218
$T_E \sim \text{sec}$	.333	.333	.333	.333
$\sigma_u \sim \text{m/sec}$	2.08	1.854	1.378	1.177
$\sigma_w \sim \text{m/sec}$	.801	1.854	1.378	1.177
$L_u \sim \text{m}$	205.	533.	533.	533.
$L_w \sim \text{m}$	30.5	533.	533.	533.

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TABLE III-4 (Concluded)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$V_{T0} \sim \text{m/sec}$	30.8	30.8	7.71	77.1	7.71	35.5
$h_o \sim \text{m}$	30.5	610.	30.5	30.5	30.5	30.5
$\alpha_o \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\gamma_o \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$l_x \sim \text{m}$	5.18	5.18	5.18	5.18	.732	.732
$b \sim \text{m}$	22.0	22.0	22.0	22.0	16.15	16.15
$X_u \sim 1/\text{sec}$	-.0227	-.0227	-.01540	-.0396	-.0284	-.0525
$Z_u \sim 1/\text{sec}$	-.0893	-.0893	0.0	.0733	0.0	.01510
$M_u \sim 1/\text{sec-m}$	.01056	.01056	.00669	.00541	.020	.0201
$Z_w \sim 1/1$	0.0	0.0	0.0	0.0	0.0	0.0
$M_w \sim 1/\text{m}$	-.000699	-.000699	0.0	-.000367	0.0	0.0
$X_w \sim 1/\text{sec}$	-.000528	-.000528	0.0	.0301	0.0	.0207
$Z_w \sim 1/\text{sec}$	-.694	-.694	-.303	-1.080	-.690	-.810
$M_w \sim 1/\text{sec-m}$	.00556	.00556	.00245	.0230	0.0	-.00758
$X_q \sim \text{m/sec}$	.515	.515	.415	.241	.832	1.161
$Z_q \sim \text{m/sec}$	.0291	.0291	.0384	.0494	0.0	-.1219
$M_q \sim 1/\text{sec}$	-.562	-.562	-.438	-.724	-.610	-1.004
$X_{oe} \sim \text{m/sec}^2$	-2.16	-2.16	34	-1.225	-1.475	-1.314
$Z_{oe} \sim \text{m/sec}^2$	-4.51	-4.51	0.0	-12.01	0.0	-3.95
$M_{oe} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$K_\theta \sim 1/1$	1.706	1.706	1.469	2.11	1.669	2.29
$T_L \sim \text{sec}$	.877	.877	.987	1.135	.828	.472
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\alpha_u \sim \text{m/sec}$	2.08	1.854	2.08	2.08	2.08	2.08
$\alpha_w \sim \text{m/sec}$	.801	1.854	.801	.801	.801	.801
$L_u \sim \text{m}$	205.	533.	205.	205.	205.	205.
$L_w \sim \text{m}$	30.5	533.	30.5	30.5	30.5	30.5

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TABLE III-5

TRIM CONDITIONS AND STABILITY DERIVATIVES. LATERAL-DIRECTIONAL, S.I. UNITS

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$V_{T_0} \sim \text{m/sec}$	33.4	33.4	33.4	38.6	32.7	43.8
$h_0 \sim \text{m}$	30.5	610.	30.5	30.5	30.5	30.5
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	5.19	5.19	-2.07	-.630	2.54	6.10
$\gamma_0 \sim \text{deg}$	-7.50	-7.50	-7.50	10.80	-6.0	-6.0
$l_x \sim \text{m}$	5.73	5.73	6.40	6.40	13.11	12.19
$l_z \sim \text{m}$	-.378	-.378	0.0	0.0	0.0	0.0
$b \sim \text{m}$	24.0	24.0	23.4	23.4	33.9	33.6
$Y_v \sim 1/\text{sec}$	-.1240	-.1240	-.1140	-.1610	-.0765	-.0851
$Y_p \sim \text{m/sec}$	0.0	0.0	0.0	0.0	.297	0.0
$Y_r \sim \text{m/sec}$	0.0	0.0	0.0	0.0	.1446	0.0
$L'_\beta \sim 1/\text{sec}^2$	.0403	.0403	-.206	-.805	-.505	-.875
$L'_p \sim 1/\text{sec}$	-.624	-.624	-.786	-.704	-.625	-.750
$L'_r \sim 1/\text{sec}$	1.567	1.567	-.0970	.749	.980	1.364
$N'_\beta \sim 1/\text{sec}^2$	.534	.534	.554	.0706	.1788	.377
$N'_p \sim 1/\text{sec}$	-.232	-.232	-.1150	-.1560	-.140	-.199
$N'_r \sim 1/\text{sec}$	-.238	-.238	-.490	-.428	-.0735	-.1660
$Y_{\delta a}^* \sim 1/\text{sec}$	-.0239	-.0239	0.0	0.0	0.0	0.0
$L'_{\delta a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$N'_{\delta a} \sim 1/\text{sec}^2$	-.1476	-.1476	.00190	-.01890	.0778	.0350
$K_\phi \sim 1/1$	1.928	1.928	1.914	1.744	1.466	1.508
$T_L \sim \text{sec}$	.375	.375	.702	.709	.937	.769
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_v \sim \text{m/sec}$	2.08	1.854	2.08	2.08	2.08	2.08
$\sigma_p \sim \text{deg/sec}$	.513	.458	.522	.522	.408	.410
$L_v \sim \text{m}$	205.	533.	205.	205.	205.	205.

TABLE III-5 (Continued)

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV830-A	CV880-P	CV880-C
$V_{T_0} \sim \text{m/sec}$	36.0	36.0	41.2	68.9	187.5	255.
$h_0 \sim \text{m}$	30.5	610.	30.5	30.5	7010.	10670.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	-5.10	-5.10	-2.59	5.20	5.30	4.04
$\gamma_0 \sim \text{deg}$	-5.40	-5.40	6.78	-3.0	0.0	0.0
$l_x \sim \text{m}$	2.97	2.97	2.97	15.0	15.0	15.0
$l_z \sim \text{m}$	-619	-619	-619	-1.265	-1.265	-1.265
$b \sim \text{m}$	19.81	19.81	19.81	36.6	36.6	36.6
$Y_v \sim 1/\text{sec}$	-.1337	-.1337	-.1780	-.1390	-.1150	-.1080
$Y_p \sim \text{m/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$Y_r \sim \text{m/sec}$	0.0	0.0	0.0	0.0	0.0	0.0
$L'_p \sim 1/\text{sec}^2$	-2.21	-2.21	-2.95	-3.13	-5.82	-7.57
$L'_p \sim 1/\text{sec}$	-4.49	-4.49	-4.67	-1.30	-1.090	-.863
$L'_r \sim 1/\text{sec}$	2.47	2.47	2.46	1.080	.518	.450
$N'_p \sim 1/\text{sec}^2$	2.02	2.02	1.742	.786	1.970	2.36
$N'_p \sim 1/\text{sec}$	-.738	-.738	-.307	-.01390	.0424	.0325
$N'_r \sim 1/\text{sec}$	-.706	-.706	-.546	-.303	-.233	-.20
$Y_{\delta a} \sim 1/\text{sec}$	0.0	0.0	-.1223E-4	-.00960	-.00160	-.00130
$L_{\delta a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$N_{\delta a} \sim 1/\text{sec}^2$	.01063	.01063	.1463	.01330	-.01220	-.0218
$K_\phi \sim 1/1$	10.76	10.76	6.33	2.27	2.34	2.62
$T_L \sim \text{sec}$	0.0	0.0	0.0	.517	.411	.258
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_v \sim \text{m/sec}$	2.08	1.854	2.08	2.08	1.413	1.387
$\sigma_p \sim \text{deg/sec}$	.584	.521	.584	.388	.264	.259
$L_v \sim \text{m}$	205.	533.	205.	205.	533.	533.

TABLE III-5 (Continued)

Configuration	8747-A1	8747-A2	8747-T	8747-P	8747-C
$V_{T_0} \sim \text{m/sec}$	73.3	73.3	89.1	205.	261.
$h_0 \sim \text{m}$	30.5	610.	30.5	6100.	10670.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	4.44	4.44	10.0	2.50	1.70
$\gamma_0 \sim \text{deg}$	-3.0	-3.0	2.50	0.0	0.0
$l_x \sim \text{m}$	26.2	26.2	26.2	26.2	26.2
$l_z \sim \text{m}$	-3.05	-3.05	-3.05	-3.05	-3.05
$b \sim \text{m}$	59.6	59.6	59.6	59.6	59.6
$Y_v \sim 1/\text{sec}$	-.0935	-.0935	-.0699	-.1040	-.0765
$Y_p \sim \text{m/sec}$	1.737	1.737	1.326	0.0	0.0
$Y_r \sim \text{m/sec}$	.0631	.0631	.315	0.0	.0735
$L_p^* \sim 1/\text{sec}^2$	-1.321	-1.321	-1.240	-2.92	-3.06
$L_p^* \sim 1/\text{sec}$	-1.016	-1.016	-.757	-.791	-.559
$L_r^* \sim 1/\text{sec}$	.315	.315	.344	.344	.314
$N_p^* \sim 1/\text{sec}^2$	.273	.273	.436	1.050	-1.694
$N_p^* \sim 1/\text{sec}$	-.0909	-.0909	-.0430	-.0270	.01092
$N_r^* \sim 1/\text{sec}$	-.212	-.212	-.209	-.205	-.1738
$Y_{\delta a}^* \sim 1/\text{sec}$	0.0	0.0	0.0	0.0	0.0
$L_{\delta a}^* \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00
$N_{\delta a}^* \sim 1/\text{sec}^2$	.0337	.0337	-.0718	.0507	-.0443
$K_\phi \sim 1/1$	2.18	2.18	1.818	1.803	1.484
$T_L \sim \text{sec}$	.589	.589	.680	.846	.714
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333,
$\sigma_v \sim \text{m/sec}$	2.08	1.854	2.08	1.421	1.387
$\sigma_p \sim \text{deg/sec}$	.280	.250	.280	.1914	.1868
$L_v \sim \text{m}$	205.	533.	205.	533.	533.

TABLE III-5 (Continued)

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$V_{T_0} \sim \text{m/sec}$	105.5	105.5	265.	738.
$h_0 \sim \text{m}$	30.5	610.	12190.	18290.
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	7.50	7.50	7.50	4.40
$\gamma_0 \sim \text{deg}$	-3.0	-3.0	0.0	0.0
$l_x \sim \text{m}$	30.2	30.2	29.8	29.8
$l_z \sim \text{m}$	-2.04	-2.04	-2.04	-2.04
$b \sim \text{m}$	32.0	32.0	32.0	32.0
$Y_v \sim 1/\text{sec}$	-.0508	-.0508	-.0352	-.0548
$Y_p \sim \text{m/sec}$	0.0	0.0	0.0	0.0
$Y_r \sim \text{m/sec}$	0.0	0.0	0.0	0.0
$L'_\beta \sim 1/\text{sec}^2$	-4.88	-4.88	-6.01	2.05
$L'_p \sim 1/\text{sec}$	-1.730	-1.730	-1.220	-.411
$L'_r \sim 1/\text{sec}$	-.01120	-.01120	.241	.0412
$N'_\beta \sim 1/\text{sec}^2$	1.550	1.550	1.680	.757
$N'_p \sim 1/\text{sec}$	.0451	.0451	.206	.000752
$N'_r \sim 1/\text{sec}$	-.1780	-.1780	-.1280	-.1530
$Y_{\delta_a}^* \sim 1/\text{sec}$	-.00639	-.00639	-.504E-4	0.0
$L'_{\delta_a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00
$N'_{\delta_a} \sim 1/\text{sec}^2$	-.1777	-.1777	-.1857	-.1175
$K_\phi \sim 1/1$	1.549	1.549	2.15	1.663
$T_L \sim \text{sec}$	.1833	.1833	.0533	1.049
$T_E \sim \text{sec}$	.333	.333	.333	.333
$\sigma_v \sim \text{m/sec}$	2.08	1.854	1.378	1.177
$\sigma_p \sim \text{deg/sec}$	.424	.378	.281	.240
$L_v \sim \text{m}$	205.	533.	533.	533.

TABLE III-5 (Concluded)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$V_{T_0} \sim \text{m/sec}$	30.8	30.8	7.71	77.1	7.71	35.5
$h_0 \sim \text{m}$	30.5	610.	30.5	30.5	30.5	30.5
$\alpha_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\alpha_t \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$\gamma_0 \sim \text{deg}$	0.0	0.0	0.0	0.0	0.0	0.0
$l_x \sim \text{m}$	5.18	5.18	5.18	5.18	.823	.823
$l_z \sim \text{m}$	0.0	0.0	0.0	0.0	0.0	0.0
$b \sim \text{m}$	22.0	22.0	22.0	22.0	16.15	16.15
$Y_v \sim 1/\text{sec}$	-.0867	-.0867	-.0352	-.1540	-.0731	-.1220
$Y_p \sim \text{m/sec}$	-.579	-.579	-.436	-.378	-.914	-1.524
$Y_r \sim \text{m/sec}$	.622	.622	.259	.985	.433	.396
$L'_\beta \sim 1/\text{sec}^2$	-1.141	-1.141	-.324	-5.85	-1.316	-8.47
$L'_p \sim 1/\text{sec}$	-2.0	-2.0	-2.31	-1.790	-3.18	-4.81
$L'_r \sim 1/\text{sec}$	.227	.227	.0946	.654	.804	1.00
$N'_\beta \sim 1/\text{sec}^2$	.901	.901	.1343	2.71	.891	3.78
$N'_p \sim 1/\text{sec}$	.0471	.0471	.01660	.1150	.220	.201
$N'_r \sim 1/\text{sec}$	-.553	-.553	-.232	-.842	-1.10	-1.10
$Y'_{\delta a} \sim 1/\text{sec}$	.01450	.01450	.0586	.00573	.0436	.00651
$L'_{\delta a} \sim 1/\text{sec}^2$	1.00	1.00	1.00	1.00	1.00	1.00
$N'_{\delta a} \sim 1/\text{sec}^2$	.00409	.00409	.00384	.00937	0.0	0.0
$K_\phi \sim 1/1$	3.69	3.69	4.18	3.25	4.72	8.14
$T_L \sim \text{sec}$	.234	.234	.1908	.303	.0585	0.0
$T_E \sim \text{sec}$	.333	.333	.333	.333	.333	.333
$\sigma_v \sim \text{m/sec}$	2.08	1.854	2.08	2.08	2.08	2.08
$\sigma_p \sim \text{deg/sec}$	.544	.485	.544	.544	.669	.669
$L_v \sim \text{m}$	205.	533.	205.	205.	205.	205.

Note that the stability derivatives  $L'_{\delta_a}$  and  $M_{\delta_e}$  are unity for all configurations (c.f., Tables III-2, III-3). This was intentionally done at the time the data was compiled, and is, in effect, a scaling change accomplished by dividing  $Y_{\delta_a}$ ,  $N_{\delta_a}$  and  $X_{\delta_e}$ ,  $Z_{\delta_e}$  by the original values of  $L'_{\delta_a}$  and  $M_{\delta_e}$ , respectively. The motivation for the scaling change was to simplify the procedure for calculating the pitch and roll pilot parameters.

A caveat is in order here. The data presented in Tables III-2 and III-3 have been collected from very diverse sources over a long period of time. In a few cases the original source of the data is now unclear. Those familiar with the art will know the considerable difficulty which attends the attempt to discover definitive data. In many cases we, our colleagues, and (we suspect) our predecessors have, according to the best judgment available, altered the data as may have been indicated by internal inconsistencies or physical improbabilities revealed by the attempt to use them. For these reasons we wish to make it clear that the data are only nominally representative of the several aircraft configurations. In particular, the manufacturers of the aircraft cannot be held accountable for this information, nor would they be bound to concur in any conclusions with respect to their aircraft which might be derived from its use.



## SECTION IV

### RESULTS

The results of this study are summarized in Tables IV-1 through IV-4. Tables IV-3 and IV-4 are the S.I. unit equivalents of Tables IV-1 and IV-2, respectively.

The contents of these tables can be summarized as follows:

1. Linear and angular RMS values of the aircraft motion due to 1% probability atmospheric turbulence with and without the effects of a second order washout filter.
2. Linear and angular peak values of the aircraft motion due to a discrete wind shear (1 kt/sec lasting for 10 seconds) with and without the effects of a second order washout filter.

TABLE IV-1: LONGITUDINAL RESULTS, U.S. UNITS

## a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{x} \sim \text{ft/sec}^2$	.253	.203	.315	.237	.282	.229
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	.1366	.0925	.1497	.0976	.1084	.0946
$\dot{x} \sim \text{ft/sec}$	1.525	1.659	1.657	1.405	1.676	1.436
$\dot{x}_{wo} \sim \text{ft/sec}$	.0930	.0772	.1230	.10	.1008	.0786
$x_{wo} \sim \text{ft}$	.213	.1812	.279	.217	.261	.209
$\ddot{h}_p \sim \text{ft/sec}^2$	.486	.445	.618	.764	.562	.516
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	.399	.268	.466	.673	.393	.397
$\dot{h}_p \sim \text{ft/sec}$	.80	1.866	1.121	.915	1.213	1.045
$\dot{h}_{pwo} \sim \text{ft/sec}$	.222	.203	.299	.342	.268	.229
$h_{pwo} \sim \text{ft}$	.281	.357	.410	.368	.405	.333
$\ddot{\theta} \sim \text{deg/sec}^2$	.526	.330	.511	.854	.1367	.230
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.516	.321	.488	.828	.1221	.218
$\dot{\theta} \sim \text{deg/sec}$	.213	.1491	.282	.40	.1170	.1434
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.1940	.1337	.224	.340	.0698	.1044
$\theta \sim \text{deg}$	.207	.1589	.40	.477	.276	.290
$\theta_{wo} \sim \text{deg}$	.1093	.0806	.1582	.220	.0630	.0776

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## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind.

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{x} \sim \text{ft/sec}^2$	.423	.423	.498	.416	.495	.423
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	-.0236	-.0236	-.0333	-.0336	-.0316	-.0223
$\dot{x} \sim \text{ft/sec}$	5.15	5.15	5.17	5.15	5.24	5.19
$\dot{x}_{wo} \sim \text{ft/sec}$	.0559	.0559	.0796	.0645	.0706	.0538
$x_{wo} \sim \text{ft}$	.411	.411	.488	.403	.483	.414
$\ddot{h}_p \sim \text{ft/sec}^2$	-.1699	-.1699	-.233	-.270	-.287	-.251
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	-.0383	-.0383	-.0595	-.0724	-.0681	-.0510
$\dot{h}_p \sim \text{ft/sec}$	-1.296	-1.296	-1.481	-1.865	-2.05	-2.03
$\dot{h}_{pwo} \sim \text{ft/sec}$	.0686	.0686	.0975	.1186	.1225	.0976
$h_{pwo} \sim \text{ft}$	-.1697	-.1697	-.230	-.264	-.289	-.255
$\ddot{\theta} \sim \text{deg/sec}^2$	.0521	.0521	.1354	.0909	.0479	.0464
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.0258	-.0258	.0733	.0744	-.0274	-.01618
$\dot{\theta} \sim \text{deg/sec}$	-.0539	-.0539	-.1372	-.1488	-.0778	-.0712
$\dot{\theta}_{wo} \sim \text{deg/sec}$	-.01523	-.01523	-.0422	-.0571	-.0213	-.01411
$\theta \sim \text{deg}$	-.337	-.337	-.576	-.803	-.511	-.568
$\theta_{wo} \sim \text{deg}$	.0244	.0244	.0581	.0702	.0366	.0315

TABLE IV-1 (Continued)

## a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{x} \sim \text{ft/sec}^2$	.364	.272	.277	.1559	.0440	.0379
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	.1856	.1255	.1578	.0922	.0257	.0248
$\dot{x} \sim \text{ft/sec}$	1.693	1.746	1.385	.944	.333	.250
$\dot{x}_{wo} \sim \text{ft/sec}$	.1441	.1108	.1236	.0577	.0216	.0199
$x_{wo} \sim \text{ft}$	.314	.243	.229	.1263	.0360	.0269
$\ddot{h}_p \sim \text{ft/sec}^2$	.821	.611	1.067	.575	.504	.505
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	.647	.409	.978	.520	.415	.452
$\dot{h}_p \sim \text{ft/sec}$	1.324	1.972	1.005	.650	.423	.738
$\dot{h}_{pwo} \sim \text{ft/sec}$	.382	.286	.444	.225	.225	.204
$h_{pwo} \sim \text{ft}$	.512	.458	.436	.249	.290	.229
$\ddot{\theta} \sim \text{deg/sec}^2$	1.050	.651	1.032	.1522	.391	.720
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	1.014	.627	.996	.1504	.374	.702
$\dot{\theta} \sim \text{deg/sec}$	.543	.352	.514	.0526	.218	.345
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.446	.286	.432	.0476	.1978	.328
$\theta \sim \text{deg}$	.753	.525	.636	.0575	.1665	.211
$\theta_{wo} \sim \text{deg}$	.285	.1874	.284	.0248	.1223	.1752

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## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{x} \sim \text{ft/sec}^2$	.517	.517	.414	.284	.0826	.0645
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	-.0361	-.0361	-.0390	-.01354	-.00241	-.001752
$\dot{x} \sim \text{ft/sec}$	5.21	5.21	5.14	5.06	2.92	2.43
$\dot{x}_{wo} \sim \text{ft/sec}$	-.0864	-.0864	.0698	.0342	.00849	.00656
$x_{wo} \sim \text{ft}$	.511	.511	.399	.281	.0829	.0646
$\ddot{h}_p \sim \text{ft/sec}^2$	.286	.286	-.292	-.1684	-.1364	-.1250
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	-.0685	-.0685	-.0837	-.0385	.0203	.01565
$\dot{h}_p \sim \text{ft/sec}$	-1.633	-1.633	-1.812	-1.428	-1.329	-1.234
$\dot{h}_{pwo} \sim \text{ft/sec}$	.1160	.1160	.1293	.0650	.0327	.0257
$h_{pwo} \sim \text{ft}$	.277	.277	-.272	-.1706	-.1366	-.1234
$\ddot{\theta} \sim \text{deg/sec}^2$	.296	.296	.1401	.00721	.00518	-.00415
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.1886	.1886	.1107	.00340	-.00203	.001461
$\dot{\theta} \sim \text{deg/sec}$	-.254	-.254	-.1977	-.01396	-.01780	-.01510
$\dot{\theta}_{wo} \sim \text{deg/sec}$	-.0893	-.0893	-.0782	-.00357	.00277	.001854
$\theta \sim \text{deg}$	-1.107	-1.107	-1.049	-.1188	-.1735	-.1495
$\theta_{wo} \sim \text{deg}$	.1172	.1172	.0939	.00558	.00422	.00332

TABLE IV-1 (Continued)

## a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{x} \sim \text{ft/sec}^2$	.1243	.1321	.0833	.0364	.0430
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	.0607	.0509	.0350	.0205	.0290
$\dot{x} \sim \text{ft/sec}$	.907	1.186	.692	.309	.307
$\dot{x}_{wo} \sim \text{ft/sec}$	.0415	.0461	.0319	.01740	.0209
$x_{wo} \sim \text{ft}$	.1087	.1222	.0758	.0303	.0320
$\ddot{h}_p \sim \text{ft/sec}^2$	.489	.540	.397	.473	.381
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	.405	.333	.349	.382	.324
$\dot{h}_p \sim \text{ft/sec}$	.852	1.801	.625	.888	.650
$\dot{h}_{pwo} \sim \text{ft/sec}$	.206	.254	.1511	.219	.1693
$h_{pwo} \sim \text{ft}$	.276	.428	.1909	.282	.203
$\ddot{\theta} \sim \text{deg/sec}^2$	.140	.1322	.1707	.243	.346
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.1320	.1201	.1635	.229	.329
$\dot{\theta} \sim \text{deg/sec}$	.0867	.0978	.0912	.1457	.1973
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.0632	.0701	.0740	.1284	.1791
$\theta \sim \text{deg}$	.1714	.1945	.1461	.1270	.1475
$\theta_{wo} \sim \text{deg}$	.0482	.0568	.0511	.0852	.1129

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## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{x} \sim \text{ft/sec}^2$	.266	.266	.1969	.0774	.1141
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	-.01052	-.01052	-.00848	-.0020	-.00638
$\dot{x} \sim \text{ft/sec}$	5.07	5.07	4.79	2.79	3.46
$\dot{x}_{wo} \sim \text{ft/sec}$	.0301	.0301	.0213	.00790	.01252
$x_{wo} \sim \text{ft}$	.266	.266	.1985	.0774	.1113
$\ddot{h}_p \sim \text{ft/sec}^2$	-.234	-.234	-.261	-.160	.01245
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	.0429	.0429	.0392	.0211	-.00351
$\dot{h}_p \sim \text{ft/sec}$	-2.11	-2.11	-2.45	-1.567	.1119
$\dot{h}_{pwo} \sim \text{ft/sec}$	.0757	.0757	.0717	.0347	-.00396
$h_{pwo} \sim \text{ft}$	-.237	-.237	-.262	-.1590	.01184
$\ddot{\theta} \sim \text{deg/sec}^2$	.01896	.01896	.01457	.00548	-.01204
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.00735	-.00736	-.01021	-.00226	.00916
$\dot{\theta} \sim \text{deg/sec}$	-.0448	-.0448	-.0399	-.01842	.01389
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.00708	.00708	.00356	.00223	.00556
$\theta \sim \text{deg}$	-.404	-.404	-.375	-.1801	.0892
$\theta_{wo} \sim \text{deg}$	.01598	.01598	.01011	.00457	-.00617

TABLE IV-1 (Continued)

## a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{x} \sim \text{ft/sec}^2$	.0492	.0518	.0647	.0338
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	.0318	.0328	.060	.0309
$\dot{x} \sim \text{ft/sec}$	.429	.599	.281	.0713
$\dot{x}_{wo} \sim \text{ft/sec}$	.0211	.0230	.0336	.01968
$x_{wo} \sim \text{ft}$	.0378	.0403	.0251	.01421
$\ddot{h}_p \sim \text{ft/sec}^2$	.734	.772	.408	.233
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	.714	.623	.366	.223
$\dot{h}_p \sim \text{ft/sec}$	.480	1.544	.589	.1923
$\dot{h}_{pwo} \sim \text{ft/sec}$	.1938	.351	.1661	.1135
$h_{pwo} \sim \text{ft}$	.1753	.461	.1848	.0708
$\ddot{\theta} \sim \text{deg/sec}^2$	.430	.406	.464	.353
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.425	.394	.451	.334
$\dot{\theta} \sim \text{deg/sec}$	.1358	.1864	.212	.209
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.1258	.1697	.1949	.1935
$\theta \sim \text{deg}$	.1221	.1683	.1489	.1377
$\theta_{wo} \sim \text{deg}$	.0669	.1010	.1170	.1225

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## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{x} \sim \text{ft/sec}^2$	.1037	.1037	-.0256	.01899
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	-.00508	-.00508	.00261	-.000698
$\dot{x} \sim \text{ft/sec}$	3.31	3.31	-1.010	.788
$\dot{x}_{wo} \sim \text{ft/sec}$	.01125	.01125	-.00322	.001617
$x_{wo} \sim \text{ft}$	.1025	.1025	-.0254	.01898
$\ddot{h}_p \sim \text{ft/sec}^2$	-.1696	-.1696	-.0586	-.0391
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	.0273	.0273	.00795	.00287
$\dot{h}_p \sim \text{ft/sec}$	-1.641	-1.641	-.789	-.874
$\dot{h}_{pwo} \sim \text{ft/sec}$	.0446	.0446	-.01117	-.00469
$h_{pwo} \sim \text{ft}$	-.1705	-.1705	-.0557	-.0371
$\ddot{\theta} \sim \text{deg/sec}^2$	.01203	.01203	-.0218	-.00266
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.00587	-.00587	.01528	.001947
$\dot{\theta} \sim \text{deg/sec}$	-.0316	-.0316	.0235	-.00375
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.00635	.00635	.00957	.001433
$\theta \sim \text{deg}$	-.306	-.306	.1349	-.0403
$\theta_{wo} \sim \text{deg}$	.00921	.00921	-.0100	-.001237

TABLE IV-1 (Concluded)

## a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{x} \sim \text{ft/sec}^2$	.1076	.0893	.0786	.1189	.1471	.1739
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	.0338	.0252	.0214	.0509	.0460	.0616
$\dot{x} \sim \text{ft/sec}$	1.124	1.343	1.551	.819	1.843	1.307
$\dot{x}_{wo} \sim \text{ft/sec}$	.0391	.0305	.0271	.0471	.0568	.0677
$x_{wo} \sim \text{ft}$	.1025	.0859	.0759	.1078	.1402	.1632
$\ddot{h}_p \sim \text{ft/sec}^2$	.545	.476	.205	.928	.356	.599
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	.489	.324	.1444	.884	.263	.543
$\dot{h}_p \sim \text{ft/sec}$	.596	1.773	.532	.565	.669	.540
$\dot{h}_{pwo} \sim \text{ft/sec}$	.237	.224	.0953	.306	.1826	.278
$h_{pwo} \sim \text{ft}$	.246	.351	.1469	.290	.243	.260
$\ddot{\theta} \sim \text{deg/sec}^2$	1.118	.707	.512	1.964	.90	1.780
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	1.078	.670	.476	1.944	.839	1.734
$\dot{\theta} \sim \text{deg/sec}$	.550	.405	.330	.586	.572	.784
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.463	.322	.249	.514	.435	.687
$\theta \sim \text{deg}$	.706	.606	.542	.586	.913	.876
$\theta_{wo} \sim \text{deg}$	.311	.237	.1959	.293	.338	.425

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## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{x} \sim \text{ft/sec}^2$	.230	.230	.1836	.247	.358	.339
$\ddot{x}_{wo} \sim \text{ft/sec}^2$	-.01102	-.01102	-.00770	-.01043	-.0225	-.0216
$\dot{x} \sim \text{ft/sec}$	4.81	4.81	4.47	4.91	5.13	5.11
$\dot{x}_{wo} \sim \text{ft/sec}$	.0294	.0294	.0221	.0311	.0523	.0482
$x_{wo} \sim \text{ft}$	.228	.228	.1832	.245	.356	.331
$\ddot{h}_p \sim \text{ft/sec}^2$	-.1050	-.1050	-.01304	-.0922	-.0367	-.0775
$\ddot{h}_{pwo} \sim \text{ft/sec}^2$	-.01871	-.01871	.00291	-.01690	-.00598	-.01813
$\dot{h}_p \sim \text{ft/sec}$	-.906	-.906	-.1237	-.654	-.271	-.562
$\dot{h}_{pwo} \sim \text{ft/sec}$	.0328	.0328	.00373	.0344	.01399	.0332
$h_{pwo} \sim \text{ft}$	-.1064	-.1064	-.01312	-.0902	-.0363	-.0744
$\ddot{\theta} \sim \text{deg/sec}^2$	.1386	.1386	.0969	.0770	.267	.216
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.0711	-.0711	-.0467	.0276	.1408	-.1372
$\dot{\theta} \sim \text{deg/sec}$	-.1860	-.1860	-.1377	-.1397	-.351	-.271
$\dot{\theta}_{wo} \sim \text{deg/sec}$	-.0545	-.0545	-.0369	-.0290	-.1037	-.0908
$\theta \sim \text{deg}$	-1.369	-1.369	-1.102	-.984	-2.15	-1.528
$\theta_{wo} \sim \text{deg}$	.0793	.0793	.0554	.0515	.1534	.1210

TABLE IV-2: LATERAL-DIRECTIONAL RESULTS, U.S. UNITS

## a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{y}_p \sim \text{ft/sec}^2$	-.858	-.858	.495	2.33	-.307	-.266
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	-.1248	-.1248	-.0627	-.1774	-.0605	-.0756
$\dot{y}_p \sim \text{ft/sec}$	-5.78	-5.78	4.32	24.0	.891	-.862
$\dot{y}_{pwo} \sim \text{ft/sec}$	-.259	-.259	.1239	.429	.0848	-.0874
$y_{pwo} \sim \text{ft}$	-.847	-.847	.495	2.27	-.297	-.229
$\ddot{\phi} \sim \text{deg/sec}^2$	-.276	-.276	-.1235	-.354	-.1777	-.235
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	.1625	.1625	.0704	-.231	.1443	.1937
$\dot{\phi} \sim \text{deg/sec}$	-.451	-.451	.1346	.477	.20	-.251
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.1472	.1472	.0635	.1544	-.1126	-.1510
$\phi \sim \text{deg}$	-1.410	-1.410	.291	1.848	-.688	-.571
$\phi_{wo} \sim \text{deg}$	-.1749	-.1749	-.0566	-.204	-.1201	-.1521
$\ddot{\psi} \sim \text{deg/sec}^2$	-.456	-.456	-.402	-.1442	.304	-.322
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	-.1640	-.1640	.245	-.0807	.0821	.1130
$\dot{\psi} \sim \text{deg/sec}$	-1.784	-1.784	-.870	.372	-1.130	-.834
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.1904	.1904	-.1858	.0910	-.1072	-.1333
$\psi \sim \text{deg}$	-12.88	-12.88	-7.09	3.54	-10.16	-7.46
$\psi_{wo} \sim \text{deg}$	-.858	.495	2.33	-.307	-.266	-.251

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{y}_p \sim \text{ft/sec}^2$	1.601	1.103	.681	1.804	.60	.748
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	.610	.404	.374	.770	.253	.407
$\dot{y}_p \sim \text{ft/sec}$	3.02	2.29	1.560	6.83	1.018	.894
$\dot{y}_{pwo} \sim \text{ft/sec}$	.823	.546	.345	.794	.305	.407
$y_{pwo} \sim \text{ft}$	1.489	1.032	.574	1.639	.548	.632
$\ddot{\phi} \sim \text{deg/sec}^2$	1.617	1.266	1.193	1.948	1.229	1.939
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	1.397	1.135	1.134	1.817	1.121	1.784
$\dot{\phi} \sim \text{deg/sec}$	1.451	1.012	.653	1.226	.855	1.269
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.859	.644	.539	.945	.625	1.005
$\phi \sim \text{deg}$	2.31	1.585	.692	1.662	1.139	1.405
$\phi_{wo} \sim \text{deg}$	.832	.576	.387	.727	.519	.786
$\ddot{\psi} \sim \text{deg/sec}^2$	1.460	.931	.871	.708	.660	.989
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.790	.502	.611	.660	.399	.737
$\dot{\psi} \sim \text{deg/sec}$	2.48	1.616	1.102	.552	1.135	1.192
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.782	.494	.539	.283	.376	.60
$\psi \sim \text{deg}$	5.84	4.75	2.67	1.204	3.66	2.75
$\psi_{wo} \sim \text{deg}$	1.103	.681	1.804	.60	.748	.671

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TABLE IV-2 (Continued)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{y}_p \sim \text{ft/sec}^2$	.759	.60	.896	1.141	.524	.708
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	.567	.432	.750	.821	.451	.637
$\dot{y}_p \sim \text{ft/sec}$	.677	.608	.755	1.385	.425	.503
$\dot{y}_{pwo} \sim \text{ft/sec}$	.395	.306	.490	.703	.322	.429
$y_{pwo} \sim \text{ft}$	.510	.420	.501	.804	.274	.320
$\ddot{\phi} \sim \text{deg/sec}^2$	5.85	4.86	6.40	4.36	3.39	5.22
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	5.80	4.82	6.30	4.08	3.19	4.94
$\dot{\phi} \sim \text{deg/sec}$	1.876	1.528	2.37	2.55	2.0	3.05
$\dot{\phi}_{wo} \sim \text{deg/sec}$	1.794	1.458	2.25	2.20	1.829	2.85
$\phi \sim \text{deg}$	1.083	.904	1.490	2.05	1.360	1.921
$\phi_{wo} \sim \text{deg}$	.842	.683	1.20	1.580	1.204	1.763
$\ddot{\psi} \sim \text{deg/sec}^2$	2.47	1.643	2.57	1.183	.829	.722
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	2.26	1.508	2.36	.956	.742	.662
$\dot{\psi} \sim \text{deg/sec}$	1.741	1.157	1.80	1.105	.60	.482
$\dot{\psi}_{wo} \sim \text{deg/sec}$	1.270	.848	1.425	.759	.506	.417
$\psi \sim \text{deg}$	2.92	2.65	2.84	1.574	.573	.422
$\psi_{wo} \sim \text{deg}$	.60	.896	1.141	.524	.708	.299

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{y}_p \sim \text{ft/sec}^2$	.237	.237	.267	.453	.1533	.1431
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	-.0760	-.0760	.1170	.1234	.0685	.0758
$\dot{y}_p \sim \text{ft/sec}$	1.743	1.743	1.687	2.85	.796	.583
$\dot{y}_{pwo} \sim \text{ft/sec}$	.0917	.0917	-.1132	-.1523	.0559	-.0571
$y_{pwo} \sim \text{ft}$	.1901	.1901	.217	.395	.1250	.1030
$\ddot{\phi} \sim \text{deg/sec}^2$	-.289	-.289	-.398	.377	-.408	-.646
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	-.420	-.420	-.396	-.365	.375	.473
$\dot{\phi} \sim \text{deg/sec}$	.217	.217	.274	-.340	-.293	.431
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.1882	.1882	.243	-.273	-.237	-.308
$\phi \sim \text{deg}$	-.1379	-.1379	-.238	.568	.283	-.279
$\phi_{wo} \sim \text{deg}$	-.0861	-.0861	.1606	.251	.1658	.1984
$\ddot{\psi} \sim \text{deg/sec}^2$	-.756	-.766	.676	.269	-.1536	.1309
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	-.424	-.424	-.382	-.1431	-.1104	-.0738
$\dot{\psi} \sim \text{deg/sec}$	-.896	-.896	-.80	-.494	-.233	-.1777
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.232	.232	.237	-.1261	.0941	.0635
$\psi \sim \text{deg}$	-7.62	-7.62	-6.73	-3.83	-1.581	-1.178
$\psi_{wo} \sim \text{deg}$	.237	.267	.453	.1533	.1431	-.0672



TABLE IV-2 (Continued)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{y}_p \sim \text{ft/sec}^2$	.741	.503	.569	.404	.503
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	.561	.340	.441	.343	.437
$\dot{y}_p \sim \text{ft/sec}$	1.181	1.171	.753	.354	.387
$\dot{y}_{pwo} \sim \text{ft/sec}$	.320	.214	.242	.225	.317
$y_{pwo} \sim \text{ft}$	.489	.373	.360	.218	.257
$\ddot{\phi} \sim \text{deg/sec}^2$	1.678	1.088	1.552	1.378	1.581
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	1.569	1.017	1.446	1.254	1.449
$\dot{\phi} \sim \text{deg/sec}$	1.015	.662	.958	.908	1.039
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.805	.518	.759	.770	.915
$\phi \sim \text{deg}$	1.053	.733	.988	.739	.780
$\phi_{wo} \sim \text{deg}$	.618	.40	.586	.591	.658
$\ddot{\psi} \sim \text{deg/sec}^2$	.470	.304	.474	.621	.60
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.325	.203	.325	.512	.533
$\dot{\psi} \sim \text{deg/sec}$	.607	.435	.607	.535	.441
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.284	.1786	.287	.412	.365
$\psi \sim \text{deg}$	1.260	1.215	1.175	.565	.418
$\psi_{wo} \sim \text{deg}$	.503	.568	.404	.503	.286

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{y}_p \sim \text{ft/sec}^2$	.426	.426	.274	.1483	.1190
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	-.0443	-.0443	-.0357	-.0467	-.0574
$\dot{y}_p \sim \text{ft/sec}$	3.48	3.48	2.06	.952	.457
$\dot{y}_{pwo} \sim \text{ft/sec}$	-.0879	-.0879	.0617	-.0450	.0491
$y_{pwo} \sim \text{ft}$	.418	.418	.265	.1333	.0837
$\ddot{\phi} \sim \text{deg/sec}^2$	.1865	.1865	.1547	-.1576	.1762
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	.1508	.1508	.1294	.1405	.1685
$\dot{\phi} \sim \text{deg/sec}$	.228	.228	.1894	-.1459	-.1447
$\dot{\phi}_{wo} \sim \text{deg/sec}$	-.1077	-.1077	-.0950	-.1067	.1265
$\phi \sim \text{deg}$	.488	.488	.390	.1850	.1507
$\phi_{wo} \sim \text{deg}$	-.1020	-.1020	-.0923	-.1001	-.1002
$\ddot{\psi} \sim \text{deg/sec}^2$	-.1496	-.1496	-.1350	-.1184	-.1133
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.0563	.0563	.0509	.0812	.0703
$\dot{\psi} \sim \text{deg/sec}$	-.433	-.433	-.407	-.232	-.1706
$\dot{\psi}_{wo} \sim \text{deg/sec}$	-.0657	-.0657	-.0558	-.0729	.0643
$\psi \sim \text{deg}$	-3.51	-3.51	-3.20	-1.441	-1.153
$\psi_{wo} \sim \text{deg}$	.426	.274	.1483	.1190	-.0662

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TABLE IV-2 (Continued)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{y}_p \sim \text{ft/sec}^2$	2.84	1.821	.493	.233
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	2.47	1.524	.367	.214
$\dot{y}_p \sim \text{ft/sec}$	2.21	1.683	.564	.1295
$\dot{y}_{pwo} \sim \text{ft/sec}$	1.677	1.053	.293	.0991
$y_{pwo} \sim \text{ft}$	1.442	1.019	.342	.0950
$\ddot{\phi} \sim \text{deg/sec}^2$	6.10	3.86	2.28	.509
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	5.77	3.66	2.18	.462
$\dot{\phi} \sim \text{deg/sec}$	3.49	2.18	1.192	.318
$\dot{\phi}_{wo} \sim \text{deg/sec}$	3.14	1.942	1.043	.244
$\phi \sim \text{deg}$	2.65	1.808	.985	.296
$\phi_{wo} \sim \text{deg}$	2.09	1.304	.686	.218
$\ddot{\psi} \sim \text{deg/sec}^2$	1.522	.931	.222	.268
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	1.388	.840	.20	.208
$\dot{\psi} \sim \text{deg/sec}$	1.052	.680	.1816	.246
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.891	.548	.1080	.1786
$\psi \sim \text{deg}$	.969	.843	.306	.243
$\psi_{wo} \sim \text{deg}$	1.821	.493	.233	.1735

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{y}_p \sim \text{ft/sec}^2$	.569	.569	.212	.0334
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	.237	.237	-.0649	.0206
$\dot{y}_p \sim \text{ft/sec}$	3.72	3.72	.804	.216
$\dot{y}_{pwo} \sim \text{ft/sec}$	-.244	-.244	.0823	-.0210
$y_{pwo} \sim \text{ft}$	.473	.473	.1770	.0302
$\ddot{\phi} \sim \text{deg/sec}^2$	.489	.489	-.238	-.0658
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	.454	.454	.237	.0497
$\dot{\phi} \sim \text{deg/sec}$	-.433	-.433	.215	-.0698
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.327	.327	-.1679	.0460
$\phi \sim \text{deg}$	.756	.756	.405	.0653
$\phi_{wo} \sim \text{deg}$	.250	.250	-.1344	-.0473
$\ddot{\psi} \sim \text{deg/sec}^2$	.1869	.1869	-.0515	.0558
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	-.1343	-.1343	-.0205	.0410
$\dot{\psi} \sim \text{deg/sec}$	-.286	-.286	-.1562	-.0724
$\dot{\psi}_{wo} \sim \text{deg/sec}$	-.1022	-.1022	.01938	-.0394
$\psi \sim \text{deg}$	-2.29	-2.29	-1.140	-.450
$\psi_{wo} \sim \text{deg}$	.569	.212	.0334	.0465

TABLE IV-2 (Concluded)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{y}_p \sim \text{ft/sec}^2$	.652	.491	.524	1.422	.960	1.329
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	.427	.322	.229	1.232	.583	1.165
$\dot{y}_p \sim \text{ft/sec}$	.963	.859	1.735	1.286	3.34	1.155
$\dot{y}_{pwo} \sim \text{ft/sec}$	.380	.278	.228	.847	.494	.715
$y_{pwo} \sim \text{ft}$	.499	.375	.474	.729	.769	.654
$\ddot{\phi} \sim \text{deg/sec}^2$	3.17	2.51	1.774	8.22	4.33	12.08
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	3.05	2.43	1.710	7.95	4.20	11.92
$\dot{\phi} \sim \text{deg/sec}$	1.533	1.156	.878	4.01	2.03	4.53
$\dot{\phi}_{wo} \sim \text{deg/sec}$	1.354	1.033	.739	3.76	1.807	4.36
$\phi \sim \text{deg}$	1.257	.944	1.078	2.48	1.827	2.41
$\phi_{wo} \sim \text{deg}$	.883	.651	.494	2.20	1.137	2.16
$\ddot{\psi} \sim \text{deg/sec}^2$	1.363	.783	.549	2.29	1.489	3.92
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	1.028	.585	.214	2.14	1.213	3.74
$\dot{\psi} \sim \text{deg/sec}$	1.511	.909	1.665	1.409	1.857	2.21
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.871	.499	.251	1.211	.842	1.886
$\psi \sim \text{deg}$	3.33	2.98	10.99	1.410	7.33	2.90
$\psi_{wo} \sim \text{deg}$	.491	.524	1.422	.960	1.329	1.216

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{y}_p \sim \text{ft/sec}^2$	.316	.316	.515	.423	1.121	.448
$\ddot{y}_{pwo} \sim \text{ft/sec}^2$	-.0677	-.0677	.01932	.1417	-.307	-.218
$\dot{y}_p \sim \text{ft/sec}$	2.49	2.49	4.83	2.75	8.95	2.63
$\dot{y}_{pwo} \sim \text{ft/sec}$	-.1115	-.1115	-.0953	-.1602	-.428	.1931
$y_{pwo} \sim \text{ft}$	.297	.297	.517	.330	1.004	.305
$\ddot{\phi} \sim \text{deg/sec}^2$	.272	.272	.304	.822	-1.429	-1.126
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	-.282	-.282	-.238	-.576	-1.204	-1.10
$\dot{\phi} \sim \text{deg/sec}$	-.282	-.282	-.433	-.518	1.364	.776
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.206	.206	.1534	.331	.791	-.681
$\phi \sim \text{deg}$	.513	.513	1.142	.627	2.19	.733
$\phi_{wo} \sim \text{deg}$	.1708	.1708	.1705	.244	-.624	-.387
$\ddot{\psi} \sim \text{deg/sec}^2$	.609	.609	.929	.421	1.675	-1.069
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.360	.360	-.323	-.234	1.686	.732
$\dot{\psi} \sim \text{deg/sec}$	-1.106	-1.106	-4.03	-.454	-3.04	-1.00
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.309	.309	.411	-.1318	-1.001	-.366
$\psi \sim \text{deg}$	-8.66	-8.66	-31.8	-3.32	-18.92	-7.26
$\psi_{wo} \sim \text{deg}$	.316	.515	.423	1.121	.448	-.430

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TABLE IV-3: LONGITUDINAL RESULTS, S.I. UNITS

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{x} \sim \text{m/sec}^2$	.829	.666	1.035	.778	.924	.752
$\ddot{x}_{wo} \sim \text{m/sec}^2$	.448	.303	.491	.320	.356	.311
$\dot{x} \sim \text{m/sec}$	5.0	5.44	5.44	4.61	5.50	4.71
$\dot{x}_{wo} \sim \text{m/sec}$	.305	.253	.404	.328	.331	.258
$x_{wo} \sim \text{m}$	.70	.595	.914	.712	.855	.687
$\ddot{h}_p \sim \text{m/sec}^2$	1.594	1.459	2.03	2.51	1.844	1.693
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	1.309	.879	1.530	2.21	1.290	1.302
$\dot{h}_p \sim \text{m/sec}$	2.63	5.12	3.68	3.0	3.98	3.43
$\dot{h}_{pwo} \sim \text{m/sec}$	.729	.665	.980	1.121	.879	.752
$h_{pwo} \sim \text{m}$	.921	1.172	1.345	1.207	1.330	1.093
$\ddot{\theta} \sim \text{deg/sec}^2$	.526	.330	.511	.854	.1367	.230
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.516	.321	.488	.828	.1221	.218
$\dot{\theta} \sim \text{deg/sec}$	.213	.1491	.282	.40	.1170	.1434
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.1940	.1337	.224	.340	.0698	.1044
$\theta \sim \text{deg}$	.207	.1589	.40	.477	.276	.290
$\theta_{wo} \sim \text{deg}$	.1093	.0806	.1582	.220	.0630	.0776

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{x} \sim \text{m/sec}^2$	1.386	1.386	1.633	1.365	1.623	1.388
$\ddot{x}_{wo} \sim \text{m/sec}^2$	-.0774	-.0774	-.1092	-.1102	-.1036	-.0733
$\dot{x} \sim \text{m/sec}$	16.89	16.89	16.96	16.88	17.18	17.01
$\dot{x}_{wo} \sim \text{m/sec}$	.1834	.1834	.261	.212	.232	.1765
$x_{wo} \sim \text{m}$	1.347	1.347	1.601	1.322	1.584	1.358
$\ddot{h}_p \sim \text{m/sec}^2$	-.558	-.558	-.764	-.885	-.940	-.823
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	-.1256	-.1256	-.1952	-.238	-.223	-.1673
$\dot{h}_p \sim \text{m/sec}$	-4.25	-4.25	-4.86	-6.12	-6.72	-6.66
$\dot{h}_{pwo} \sim \text{m/sec}$	.225	.225	.320	.389	.402	.320
$h_{pwo} \sim \text{m}$	-.557	-.557	-.754	-.867	-.947	-.838
$\ddot{\theta} \sim \text{deg/sec}^2$	.0521	.0521	.1354	.0909	.0479	.0464
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.0258	-.0258	.0733	.0744	-.0274	-.01618
$\dot{\theta} \sim \text{deg/sec}$	-.0539	-.0539	-.1372	-.1488	-.0778	-.0712
$\dot{\theta}_{wo} \sim \text{deg/sec}$	-.01523	-.01523	-.0422	-.0571	-.0213	-.01411
$\theta \sim \text{deg}$	-.337	-.337	-.576	-.803	-.511	-.568
$\theta_{wo} \sim \text{deg}$	.0244	.0244	.0581	.0702	.0366	.0315

TABLE IV-3. (Continued)

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## a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{x} \sim \text{m/sec}^2$	1.193	.893	.908	.512	.1445	.1242
$\ddot{x}_{wo} \sim \text{m/sec}^2$	.609	.412	.518	.302	.0843	.0814
$\dot{x} \sim \text{m/sec}$	5.56	5.73	4.54	3.10	1.091	.819
$\dot{x}_{wo} \sim \text{m/sec}$	.473	.364	.406	.1894	.0708	.0654
$x_{wo} \sim \text{m}$	1.031	.796	.750	.414	.1182	.0947
$\ddot{h}_p \sim \text{m/sec}^2$	2.70	2.01	3.50	1.886	1.654	1.656
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	2.12	1.341	3.21	1.706	1.361	1.482
$\dot{h}_p \sim \text{m/sec}$	4.34	6.47	3.30	2.13	3.03	2.42
$\dot{h}_{pwo} \sim \text{m/sec}$	1.255	.938	1.458	.739	.738	.668
$h_{pwo} \sim \text{m}$	1.679	1.504	1.430	.816	.951	.750
$\ddot{\theta} \sim \text{deg/sec}^2$	1.050	.651	1.032	.1522	.391	.720
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	1.014	.627	.996	.1504	.374	.702
$\dot{\theta} \sim \text{deg/sec}$	.543	.352	.514	.0526	.218	.345
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.446	.286	.432	.0476	.1978	.328
$\theta \sim \text{deg}$	.753	.525	.636	.0575	.1665	.211
$\theta_{wo} \sim \text{deg}$	.285	.1874	.284	.0248	.1223	.1752

## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{x} \sim \text{m/sec}^2$	1.697	1.697	1.359	.932	.271	.212
$\ddot{x}_{wo} \sim \text{m/sec}^2$	-.1185	-.1185	-.1278	-.0444	-.00792	-.00575
$\dot{x} \sim \text{m/sec}$	17.09	17.09	16.88	16.59	9.57	7.97
$\dot{x}_{wo} \sim \text{m/sec}$	-.283	-.283	.229	.1123	.0279	.0215
$x_{wo} \sim \text{m}$	1.677	1.677	1.310	.923	.272	.212
$\ddot{h}_p \sim \text{m/sec}^2$	.938	.938	-.958	-.552	-.447	-.410
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	-.225	-.225	-.275	-.1262	.0667	.0514
$\dot{h}_p \sim \text{m/sec}$	-5.36	-5.36	-5.95	-4.69	-4.36	-4.05
$\dot{h}_{pwo} \sim \text{m/sec}$	.381	.381	.424	.213	.1072	.0843
$h_{pwo} \sim \text{m}$	.909	.909	-.891	-.560	-.448	-.405
$\ddot{\theta} \sim \text{deg/sec}^2$	.296	.296	.1401	.00721	.00518	-.00415
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.1886	.1886	.1107	.00340	-.00203	.001461
$\dot{\theta} \sim \text{deg/sec}$	-.254	-.254	-.1977	-.01396	-.01780	-.01510
$\dot{\theta}_{wo} \sim \text{deg/sec}$	-.0893	-.0893	-.0782	-.00357	.00277	.001854
$\theta \sim \text{deg}$	-1.107	-1.107	-1.049	-.1188	-.1735	-.1495
$\theta_{wo} \sim \text{deg}$	.1172	.1172	.0939	.00558	.00422	.00332

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{x} \sim \text{m/sec}^2$	.408	.433	.273	.1193	.1410
$\ddot{x}_{wo} \sim \text{m/sec}^2$	.199	.1670	.1147	.0672	.0951
$\dot{x} \sim \text{m/sec}$	2.98	3.89	2.27	1.014	1.009
$\dot{x}_{wo} \sim \text{m/sec}$	.1360	.1513	.1047	.0571	.0684
$x_{wo} \sim \text{m}$	.357	.401	.249	.0992	.1050
$\ddot{h}_p \sim \text{m/sec}^2$	1.604	1.771	1.302	1.550	1.251
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	1.330	1.092	1.145	1.254	1.064
$\dot{h}_p \sim \text{m/sec}$	2.79	5.91	2.05	2.91	2.13
$\dot{h}_{pwo} \sim \text{m/sec}$	.677	.832	.496	.718	.556
$h_{pwo} \sim \text{m}$	.906	1.404	.626	.924	.667
$\ddot{\theta} \sim \text{deg/sec}^2$	.140	.1322	.1707	.243	.346
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.1320	.1201	.1635	.229	.329
$\dot{\theta} \sim \text{deg/sec}$	.0867	.0978	.0912	.1457	.1973
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.0632	.0701	.0740	.1284	.1791
$\theta \sim \text{deg}$	.1714	.1945	.1461	.1270	.1475
$\theta_{wo} \sim \text{deg}$	.0482	.0568	.0511	.0852	.1129

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{x} \sim \text{m/sec}^2$	.872	.872	.646	.254	.374
$\ddot{x}_{wo} \sim \text{m/sec}^2$	-.0345	-.0345	-.0278	-.00658	-.0209
$\dot{x} \sim \text{m/sec}$	16.63	16.63	15.71	9.16	11.35
$\dot{x}_{wo} \sim \text{m/sec}$	.0988	.0988	.0698	.0259	.0411
$x_{wo} \sim \text{m}$	.874	.874	.651	.254	.365
$\ddot{h}_p \sim \text{m/sec}^2$	-.769	-.769	-.856	-.525	.0408
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	.1408	.1408	.1288	.0693	-.01152
$\dot{h}_p \sim \text{m/sec}$	-6.91	-6.91	-8.03	-5.14	.367
$\dot{h}_{pwo} \sim \text{m/sec}$	.248	.248	.235	.1138	-.01298
$h_{pwo} \sim \text{m}$	-.779	-.779	-.859	-.522	.0388
$\ddot{\theta} \sim \text{deg/sec}^2$	.01896	.01896	.01457	.00548	-.01204
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.00736	-.00736	-.01021	-.00226	.00916
$\dot{\theta} \sim \text{deg/sec}$	-.0448	-.0448	-.0399	-.01842	.01389
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.00708	.00708	.00356	.00223	.00566
$\theta \sim \text{deg}$	-.404	-.404	-.375	-.1801	.0892
$\theta_{wo} \sim \text{deg}$	.01598	.01598	.01011	.00457	-.00617

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TABLE IV-3 (Continued)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{x} \sim \text{m/sec}^2$	.1615	.170	.212	.1110
$\ddot{x}_{wo} \sim \text{m/sec}^2$	.1044	.1077	.1968	.1015
$\dot{x} \sim \text{m/sec}$	1.408	1.965	.921	.234
$\dot{x}_{wo} \sim \text{m/sec}$	.0692	.0754	.1104	.0646
$x_{wo} \sim \text{m}$	.1240	.1324	.0825	.0466
$\ddot{h}_p \sim \text{m/sec}^2$	2.41	2.53	1.340	.763
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	2.34	2.04	1.20	.731
$\dot{h}_p \sim \text{m/sec}$	1.574	5.07	1.933	.631
$\dot{h}_{pwo} \sim \text{m/sec}$	.636	1.151	.545	.372
$h_{pwo} \sim \text{m}$	.575	1.514	.606	.232
$\ddot{\theta} \sim \text{deg/sec}^2$	.430	.406	.464	.353
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	.425	.394	.451	.334
$\dot{\theta} \sim \text{deg/sec}$	.1358	.1864	.212	.209
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.1258	.1697	.1949	.1935
$\theta \sim \text{deg}$	.1221	.1683	.1489	.1377
$\theta_{wo} \sim \text{deg}$	.0669	.1010	.1170	.1225

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{x} \sim \text{m/sec}^2$	.340	.340	-.0839	.0623
$\ddot{x}_{wo} \sim \text{m/sec}^2$	-.01668	-.01668	.00857	-.00229
$\dot{x} \sim \text{m/sec}$	10.88	10.88	-3.31	2.58
$\dot{x}_{wo} \sim \text{m/sec}$	.0369	.0369	-.01055	.00530
$x_{wo} \sim \text{m}$	.336	.336	-.0834	.0623
$\ddot{h}_p \sim \text{m/sec}^2$	-.556	-.556	-.1922	-.1282
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	.0896	.0896	.0251	.00942
$\dot{h}_p \sim \text{m/sec}$	-5.38	-5.38	-2.59	-2.87
$\dot{h}_{pwo} \sim \text{m/sec}$	.1463	.1463	-.0355	-.01538
$h_{pwo} \sim \text{m}$	-.559	-.559	-.1826	-.1218
$\ddot{\theta} \sim \text{deg/sec}^2$	.01203	.01203	-.0218	-.00266
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.00587	-.00587	.01528	.001947
$\dot{\theta} \sim \text{deg/sec}$	-.0316	-.0316	.0235	-.00375
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.00635	.00635	.00957	.001433
$\theta \sim \text{deg}$	-.306	-.306	.1349	-.0403
$\theta_{wo} \sim \text{deg}$	.00921	.00921	-.0100	-.001237

QUALITY

RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{x} \sim \text{m/sec}^2$	.353	.293	.258	.390	.483	.570
$\ddot{x}_{wo} \sim \text{m/sec}^2$	.1108	.0828	.0703	.1670	.1508	.202
$\dot{x} \sim \text{m/sec}$	3.69	4.41	5.09	2.69	6.05	4.29
$\dot{x}_{wo} \sim \text{m/sec}$	.1282	.0999	.0889	.1546	.1862	.222
$x_{wo} \sim \text{m}$	.336	.282	.249	.354	.460	.535
$\ddot{h}_p \sim \text{m/sec}^2$	1.789	1.561	.673	3.04	1.169	1.965
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	1.604	1.063	.474	2.90	.863	1.781
$\dot{h}_p \sim \text{m/sec}$	1.954	5.82	1.745	1.855	2.19	1.773
$\dot{h}_{pwo} \sim \text{m/sec}$	.779	.736	.313	1.004	.599	.911
$h_{pwo} \sim \text{m}$	.806	1.153	.482	.951	.799	.852
$\ddot{\theta} \sim \text{deg/sec}^2$	1.118	.707	.512	1.964	.90	1.780
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	1.078	.670	.476	1.944	.839	1.734
$\dot{\theta} \sim \text{deg/sec}$	.550	.405	.330	.586	.572	.784
$\dot{\theta}_{wo} \sim \text{deg/sec}$	.463	.322	.249	.514	.435	.687
$\theta \sim \text{deg}$	.706	.606	.542	.586	.913	.876
$\theta_{wo} \sim \text{deg}$	.311	.237	.1959	.293	.338	.425

## b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{x} \sim \text{m/sec}^2$	.756	.756	.602	.810	1.174	1.112
$\ddot{x}_{wo} \sim \text{m/sec}^2$	-.0362	-.0362	-.0252	-.0342	-.0739	-.0708
$\dot{x} \sim \text{m/sec}$	15.78	15.78	14.68	16.09	16.93	16.78
$\dot{x}_{wo} \sim \text{m/sec}$	.0964	.0964	.0726	.1019	.1716	.1582
$x_{wo} \sim \text{m}$	.746	.746	.601	.803	1.166	1.085
$\ddot{h}_p \sim \text{m/sec}^2$	-.345	-.345	-.0428	-.303	-.1204	-.254
$\ddot{h}_{pwo} \sim \text{m/sec}^2$	-.0614	-.0614	.00953	-.0554	-.01963	-.0595
$\dot{h}_p \sim \text{m/sec}$	-2.97	-2.97	-.406	-2.15	-.889	-1.844
$\dot{h}_{pwo} \sim \text{m/sec}$	.1077	.1077	.01224	.1128	.0459	.1090
$h_{pwo} \sim \text{m}$	-.349	-.349	-.0431	-.296	-.1190	-.244
$\ddot{\theta} \sim \text{deg/sec}^2$	.1396	.1396	.0969	.0770	.267	.216
$\ddot{\theta}_{wo} \sim \text{deg/sec}^2$	-.0711	-.0711	-.0467	.0276	.1408	-.1372
$\dot{\theta} \sim \text{deg/sec}$	-.1860	-.1860	-.1377	-.1397	-.351	-.271
$\dot{\theta}_{wo} \sim \text{deg/sec}$	-.0545	-.0545	-.0369	-.0290	-.1037	-.0908
$\theta \sim \text{deg}$	-1.369	-1.369	-1.102	-.984	-2.15	-1.528
$\theta_{wo} \sim \text{deg}$	.0793	.0793	.0554	.0515	.1534	.1218



TABLE IV-4: LATERAL-DIRECTIONAL RESULTS, S.I. UNITS

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a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{y}_p \sim \text{m/sec}^2$	.488	.336	.208	.550	.1829	.226
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	.1859	.1232	.1139	.235	.0771	.1241
$\dot{y}_p \sim \text{m/sec}$	.920	.698	.475	2.08	.310	.272
$\dot{y}_{pwo} \sim \text{m/sec}$	.251	.1663	.1050	.242	.0928	.1242
$y_{pwo} \sim \text{m}$	.454	.314	.1748	.50	.1689	.1927
$\ddot{\phi} \sim \text{deg/sec}^2$	1.617	1.266	1.193	1.948	1.229	1.939
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	1.397	1.135	1.134	1.817	1.121	1.784
$\dot{\phi} \sim \text{deg/sec}$	1.451	1.012	.653	1.226	.855	1.269
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.859	.644	.539	.945	.625	1.005
$\phi \sim \text{deg}$	2.31	1.585	.692	1.662	1.139	1.405
$\phi_{wo} \sim \text{deg}$	.832	.576	.387	.727	.519	.786
$\ddot{\psi} \sim \text{deg/sec}^2$	1.460	.931	.871	.708	.660	.989
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.790	.502	.611	.660	.399	.737
$\dot{\psi} \sim \text{deg/sec}$	2.48	1.616	1.102	.552	1.135	1.192
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.782	.494	.539	.283	.376	.60
$\psi \sim \text{deg}$	5.84	4.75	2.67	1.204	3.66	2.75
$\psi_{wo} \sim \text{deg}$	.336	.208	.550	.1829	.228	.671

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	AWJSRA-A1	AWJSRA-A2	BR941-A	BR941-T	STOLX-A	AMST-A
$\ddot{y}_p \sim \text{m/sec}^2$	-.262	-.262	.1509	.710	-.0935	-.0811
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	-.0380	-.0380	-.01912	-.0541	-.01844	-.0231
$\dot{y}_p \sim \text{m/sec}$	-1.763	-1.763	1.318	7.31	.271	-.263
$\dot{y}_{pwo} \sim \text{m/sec}$	-.0789	-.0789	.0378	.1309	.0259	-.0266
$y_{pwo} \sim \text{m}$	-.258	-.258	.1508	.693	-.0905	-.0698
$\ddot{\phi} \sim \text{deg/sec}^2$	-.276	-.276	-.1235	-.354	-.1777	-.235
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	.1625	.1625	.0704	-.231	.1443	.1937
$\dot{\phi} \sim \text{deg/sec}$	-.451	-.451	.1346	.477	.20	-.251
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.1472	.1472	.0635	.1544	-.1126	-.1510
$\phi \sim \text{deg}$	-1.410	-1.410	.291	1.848	-.688	-.571
$\phi_{wo} \sim \text{deg}$	-.1749	-.1749	-.0566	-.204	-.1201	-.1521
$\ddot{\psi} \sim \text{deg/sec}^2$	-.456	-.456	-.402	-.1442	.304	-.322
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	-.1640	-.1640	.245	-.0807	.0821	.1130
$\dot{\psi} \sim \text{deg/sec}$	-1.784	-1.784	-.870	.372	-1.130	-.834
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.1904	.1904	-.1858	.0910	-.1072	-.1333
$\psi \sim \text{deg}$	-12.88	-12.88	-7.09	3.54	-10.16	-7.46
$\psi_{wo} \sim \text{deg}$	-.262	.1509	.710	-.0935	-.0811	-.251

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TABLE IV-4 (Continued)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{y}_p \sim \text{m/sec}^2$	.231	.1828	.273	.348	.1597	.216
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	.1727	.1318	.229	.250	.1374	.1942
$\dot{y}_p \sim \text{m/sec}$	.206	.1853	.230	.422	.1296	.1534
$\dot{y}_{pwo} \sim \text{m/sec}$	.1203	.0932	.1493	.214	.0980	.1309
$y_{pwo} \sim \text{m}$	.1556	.1281	.1526	.245	.0636	.0976
$\ddot{\phi} \sim \text{deg/sec}^2$	5.85	4.86	6.40	4.36	3.39	5.22
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	5.80	4.82	6.30	4.08	3.19	4.94
$\dot{\phi} \sim \text{deg/sec}$	1.876	1.528	2.37	2.55	2.0	3.05
$\dot{\phi}_{wo} \sim \text{deg/sec}$	1.794	1.453	2.25	2.20	1.829	2.85
$\phi \sim \text{deg}$	1.083	.904	1.490	2.05	1.360	1.921
$\phi_{wo} \sim \text{deg}$	.842	.683	1.20	1.580	1.204	1.763
$\ddot{\psi} \sim \text{deg/sec}^2$	2.47	1.643	2.57	1.183	.829	.722
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	2.26	1.508	2.36	.956	.742	.662
$\dot{\psi} \sim \text{deg/sec}$	1.741	1.157	1.80	1.105	.60	.482
$\dot{\psi}_{wo} \sim \text{deg/sec}$	1.270	.848	1.425	.759	.506	.417
$\psi \sim \text{deg}$	2.92	2.65	2.64	1.574	.573	.422
$\psi_{wo} \sim \text{deg}$	.1828	.273	.348	.1597	.216	.299

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	DHC6-A1	DHC6-A2	DHC6-T	CV880-A	CV880-P	CV880-C
$\ddot{y}_p \sim \text{m/sec}^2$	.0721	.0721	.0813	.1380	.0467	.0436
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	-.0232	-.0232	.0356	.0376	.0209	.0231
$\dot{y}_p \sim \text{m/sec}$	.531	.531	.514	.870	.243	.1778
$\dot{y}_{pwo} \sim \text{m/sec}$	.0279	.0279	-.0345	-.0464	.01704	-.01742
$y_{pwo} \sim \text{m}$	.0579	.0579	.0662	.1204	.0381	.0314
$\ddot{\phi} \sim \text{deg/sec}^2$	-.289	-.289	-.398	.377	-.408	-.646
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	-.420	-.420	-.396	-.365	.375	.473
$\dot{\phi} \sim \text{deg/sec}$	.217	.217	.274	-.340	-.293	.431
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.1882	.1882	.243	-.273	-.237	-.308
$\phi \sim \text{deg}$	-.1379	-.1379	-.238	.568	.283	-.279
$\phi_{wo} \sim \text{deg}$	-.0861	-.0861	.1606	.251	.1658	.1984
$\ddot{\psi} \sim \text{deg/sec}^2$	-.766	-.766	.676	.269	-.1536	.1309
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	-.424	-.424	-.382	-.1431	-.1104	-.0738
$\dot{\psi} \sim \text{deg/sec}$	-.896	-.896	-.80	-.494	-.233	-.1777
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.232	.232	.237	-.1261	.0941	.0635
$\psi \sim \text{deg}$	-7.62	-7.62	-6.73	-3.83	-1.581	-1.178
$\psi_{wo} \sim \text{deg}$	.0721	.0813	.1380	.0467	.0436	-.0672

TABLE IV-4 (Continued)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{y}_p \sim \text{m/sec}^2$	.226	.1532	.1730	.1230	.1534
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	.1710	.1035	.1345	.1045	.1333
$\dot{y}_p \sim \text{m/sec}$	.360	.357	.230	.1080	.1181
$\dot{y}_{pwo} \sim \text{m/sec}$	.0975	.0653	.0736	.0686	.0966
$y_{pwo} \sim \text{m}$	.1490	.1137	.1098	.0664	.0783
$\ddot{\phi} \sim \text{deg/sec}^2$	1.678	1.088	1.552	1.378	1.581
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	1.569	1.017	1.446	1.254	1.449
$\dot{\phi} \sim \text{deg/sec}$	1.015	.662	.958	.908	1.039
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.805	.518	.759	.770	.915
$\phi \sim \text{deg}$	1.053	.733	.988	.739	.780
$\phi_{wo} \sim \text{deg}$	.618	.40	.586	.591	.658
$\ddot{\psi} \sim \text{deg/sec}^2$	.470	.304	.474	.621	.60
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.325	.203	.325	.512	.533
$\dot{\psi} \sim \text{deg/sec}$	.607	.435	.607	.535	.441
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.284	.1786	.287	.412	.365
$\psi \sim \text{deg}$	1.260	1.215	1.175	.565	.418
$\psi_{wo} \sim \text{deg}$	.1532	.1730	.1230	.2534	.286

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	B747-A1	B747-A2	B747-T	B747-P	B747-C
$\ddot{y}_p \sim \text{m/sec}^2$	.1297	.1297	.0837	.0452	.0363
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	-.01351	-.01351	-.01087	-.01422	-.01749
$\dot{y}_p \sim \text{m/sec}$	1.062	1.062	.628	.290	.1394
$\dot{y}_{pwo} \sim \text{m/sec}$	-.0268	-.0268	.01881	-.01373	.01435
$y_{pwo} \sim \text{m}$	.1274	.1274	.0808	.0406	.0255
$\ddot{\phi} \sim \text{deg/sec}^2$	.1865	.1865	.1547	-.1576	.1762
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	.1508	.1508	.1294	.1405	.1685
$\dot{\phi} \sim \text{deg/sec}$	.228	.228	.1894	-.1459	-.1447
$\dot{\phi}_{wo} \sim \text{deg/sec}$	-.1077	-.1077	-.0950	-.1067	.1265
$\phi \sim \text{deg}$	.488	.488	.390	.1850	.1507
$\phi_{wo} \sim \text{deg}$	-.1020	-.1020	-.0923	-.1001	-.1002
$\ddot{\psi} \sim \text{deg/sec}^2$	-.1496	-.1496	-.1350	-.1184	-.1133
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.0563	.0563	.0509	.0812	.0703
$\dot{\psi} \sim \text{deg/sec}$	-.433	-.433	-.407	-.232	-.1706
$\dot{\psi}_{wo} \sim \text{deg/sec}$	-.0657	-.0657	-.0558	-.0729	.0643
$\psi \sim \text{deg}$	-3.51	-3.51	-3.20	-1.441	-1.153
$\psi_{wo} \sim \text{deg}$	.1297	.0837	.0452	.0363	-.0662

TABLE IV-4 (Continued)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{y}_p \sim \text{m/sec}^2$	.855	.555	.1518	.0710
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	.752	.465	.1118	.0651
$\dot{y}_p \sim \text{m/sec}$	.673	.513	.1720	.0395
$\dot{y}_{pwo} \sim \text{m/sec}$	.511	.321	.0892	.0302
$y_{pwo} \sim \text{m}$	.440	.310	.1041	.0290
$\ddot{\phi} \sim \text{deg/sec}^2$	6.10	3.86	2.28	.509
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	5.77	3.66	2.18	.462
$\dot{\phi} \sim \text{deg/sec}$	3.49	2.18	1.192	.318
$\dot{\phi}_{wo} \sim \text{deg/sec}$	3.14	1.942	1.043	.244
$\phi \sim \text{deg}$	2.65	1.808	.985	.296
$\phi_{wo} \sim \text{deg}$	2.09	1.304	.686	.218
$\ddot{\psi} \sim \text{deg/sec}^2$	1.522	.931	.222	.268
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	1.388	.840	.20	.208
$\dot{\psi} \sim \text{deg/sec}$	1.052	.680	.1816	.246
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.891	.548	.1080	.1786
$\psi \sim \text{deg}$	.969	.843	.306	.243
$\psi_{wo} \sim \text{deg}$	.555	.1518	.0710	.1735

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	XB70A-A1	XB70A-A2	XB70A-C1	XB70A-C2
$\ddot{y}_p \sim \text{m/sec}^2$	.1736	.1736	.0645	.01019
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	.0721	.0721	-.01977	.00629
$\dot{y}_p \sim \text{m/sec}$	1.135	1.135	.245	.0658
$\dot{y}_{pwo} \sim \text{m/sec}$	-.0742	-.0742	.0251	-.00639
$y_{pwo} \sim \text{m}$	.1442	.1442	.0540	.00920
$\ddot{\phi} \sim \text{deg/sec}^2$	.489	.489	-.238	-.0658
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	.454	.454	.237	.0497
$\dot{\phi} \sim \text{deg/sec}$	-.433	-.433	.215	-.0698
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.327	.327	-.1679	.0460
$\phi \sim \text{deg}$	.756	.756	.405	.0653
$\phi_{wo} \sim \text{deg}$	.250	.250	-.1344	-.0473
$\ddot{\psi} \sim \text{deg/sec}^2$	.1869	.1869	-.0515	.0558
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	-.1343	-.1343	-.0205	.0410
$\dot{\psi} \sim \text{deg/sec}$	-.286	-.286	-.1562	-.0724
$\dot{\psi}_{wo} \sim \text{deg/sec}$	-.1022	-.1022	.01938	-.0394
$\psi \sim \text{deg}$	-2.29	-2.29	-1.140	-.450
$\psi_{wo} \sim \text{deg}$	.1736	.0645	.01019	.0465

TABLE IV-4 (Concluded)

a. RMS Response to Atmospheric Turbulence (1% Probability of Exceedance)

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{y}_p \sim \text{m/sec}^2$	.1987	.1496	.1598	.433	.293	.405
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	.1302	.0980	.0699	.376	.1778	.355
$\dot{y}_p \sim \text{m/sec}$	.293	.262	.529	.392	1.018	.352
$\dot{y}_{pwo} \sim \text{m/sec}$	.1157	.0846	.0696	.258	.1505	.218
$y_{pwo} \sim \text{m}$	.1520	.1143	.1443	.222	.234	.199
$\ddot{\phi} \sim \text{deg/sec}^2$	3.17	2.51	1.774	8.22	4.33	12.08
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	3.05	2.43	1.710	7.95	4.20	11.92
$\dot{\phi} \sim \text{deg/sec}$	1.533	1.156	.878	4.01	2.03	4.53
$\dot{\phi}_{wo} \sim \text{deg/sec}$	1.354	1.033	.739	3.76	1.807	4.36
$\phi \sim \text{deg}$	1.257	.944	1.078	2.48	1.827	2.41
$\phi_{wo} \sim \text{deg}$	.883	.651	.494	2.20	1.137	2.16
$\ddot{\psi} \sim \text{deg/sec}^2$	1.363	.783	.549	2.29	1.489	3.92
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	1.028	.585	.214	2.14	1.213	3.74
$\dot{\psi} \sim \text{deg/sec}$	1.511	.909	1.665	1.409	1.857	2.21
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.871	.499	.251	1.211	.842	1.886
$\psi \sim \text{deg}$	3.33	2.98	10.99	1.410	7.33	2.90
$\psi_{wo} \sim \text{deg}$	.1496	.1598	.433	.293	.405	1.216

Note: RMS  $\dot{y}_p$  and  $\psi$  are for  $v_g$  only

b. Peak Values Resulting from a 10 Second Ramp in Horizontal Wind

Configuration	CH53A-A1	CH53A-A2	CH53A-H	CH53A-C	H19-H	H19-C
$\ddot{y}_p \sim \text{m/sec}^2$	.0964	.0964	.1569	.1289	.342	.1366
$\ddot{y}_{pwo} \sim \text{m/sec}^2$	-.0206	-.0206	.00589	.0432	-.0937	-.0665
$\dot{y}_p \sim \text{m/sec}$	.759	.759	1.472	.839	2.73	.801
$\dot{y}_{pwo} \sim \text{m/sec}$	-.0340	-.0340	-.0291	-.0488	-.1306	.0588
$y_{pwo} \sim \text{m}$	.0905	.0905	.1577	.1007	.306	.0928
$\ddot{\phi} \sim \text{deg/sec}^2$	.272	.272	.304	.822	-1.429	-1.126
$\ddot{\phi}_{wo} \sim \text{deg/sec}^2$	-.282	-.282	-.238	-.576	-1.204	-1.10
$\dot{\phi} \sim \text{deg/sec}$	-.282	-.282	-.433	-.518	1.364	.776
$\dot{\phi}_{wo} \sim \text{deg/sec}$	.206	.206	.1534	.331	.791	-.661
$\phi \sim \text{deg}$	.513	.513	1.142	.627	2.19	.733
$\phi_{wo} \sim \text{deg}$	.1708	.1708	.1705	.244	-.624	-.387
$\ddot{\psi} \sim \text{deg/sec}^2$	.609	.609	.929	.421	1.675	-1.069
$\ddot{\psi}_{wo} \sim \text{deg/sec}^2$	.360	.360	-.323	-.234	1.686	.732
$\dot{\psi} \sim \text{deg/sec}$	-1.106	-1.106	-4.03	-.454	-3.04	-1.00
$\dot{\psi}_{wo} \sim \text{deg/sec}$	.309	.309	.411	-.1318	-1.001	-.366
$\psi \sim \text{deg}$	-8.66	-8.66	-31.8	-3.32	-18.92	-7.26
$\psi_{wo} \sim \text{deg}$	.0964	.1569	.1289	.342	.1366	-.430